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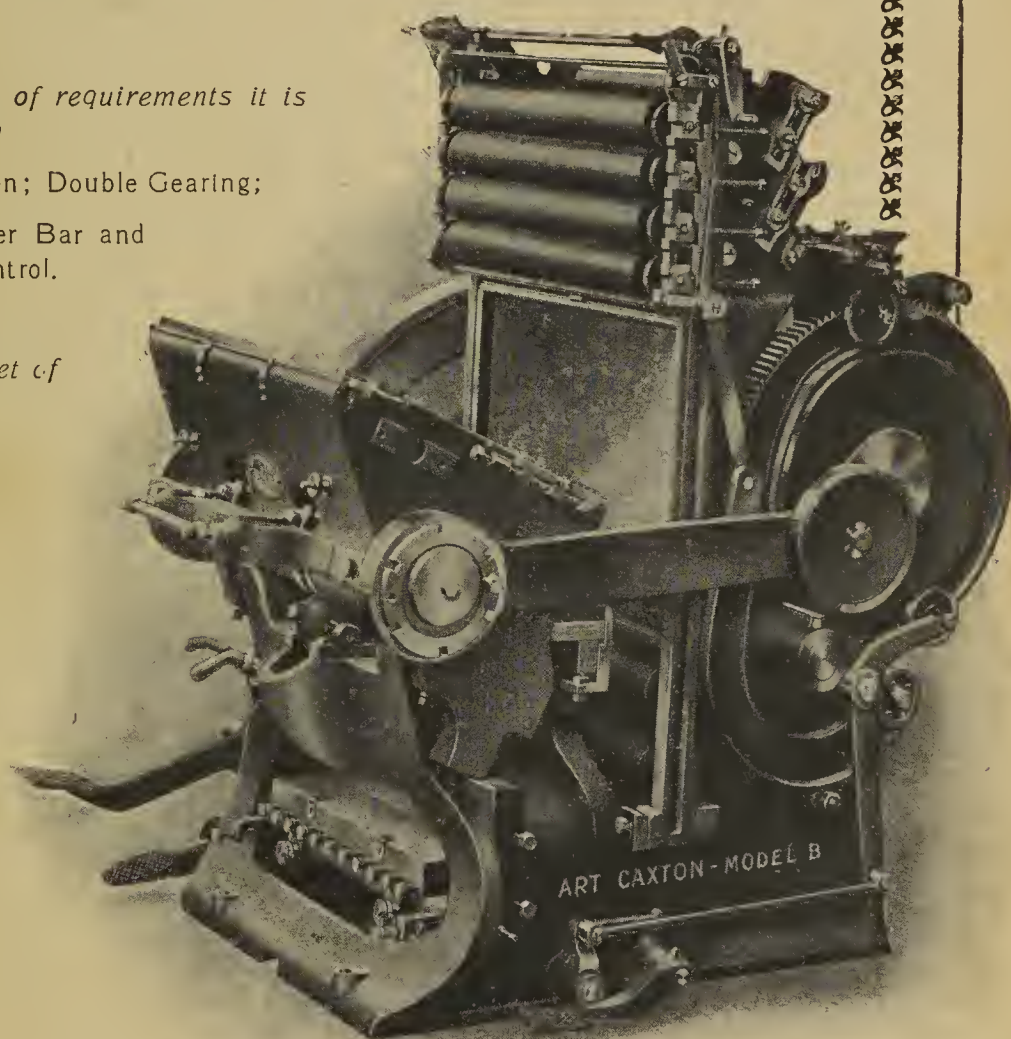
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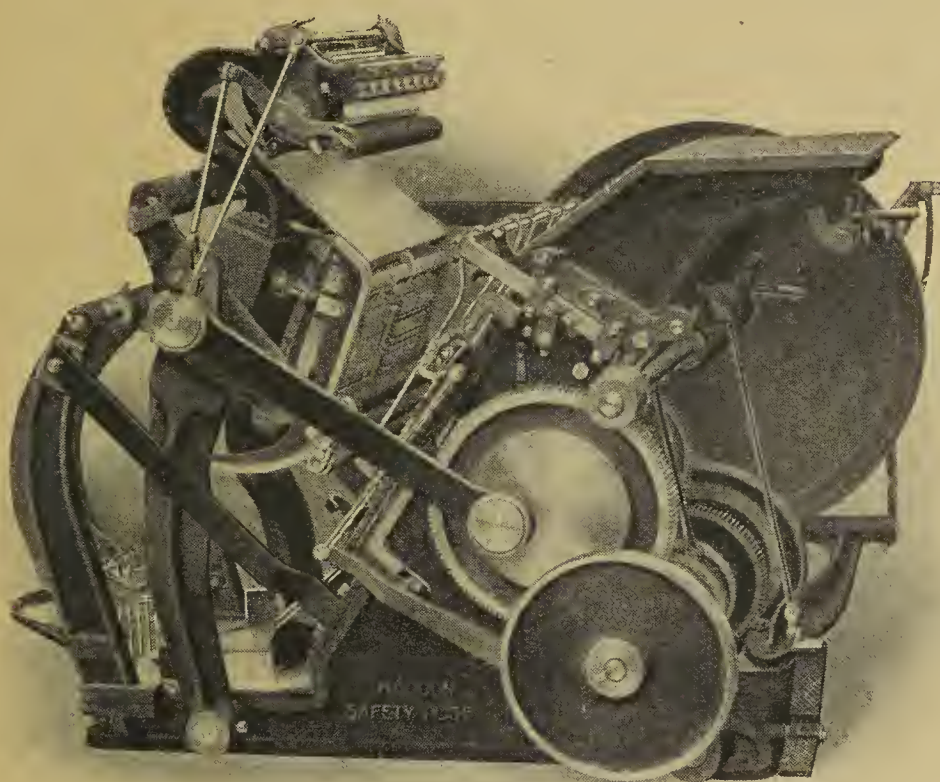
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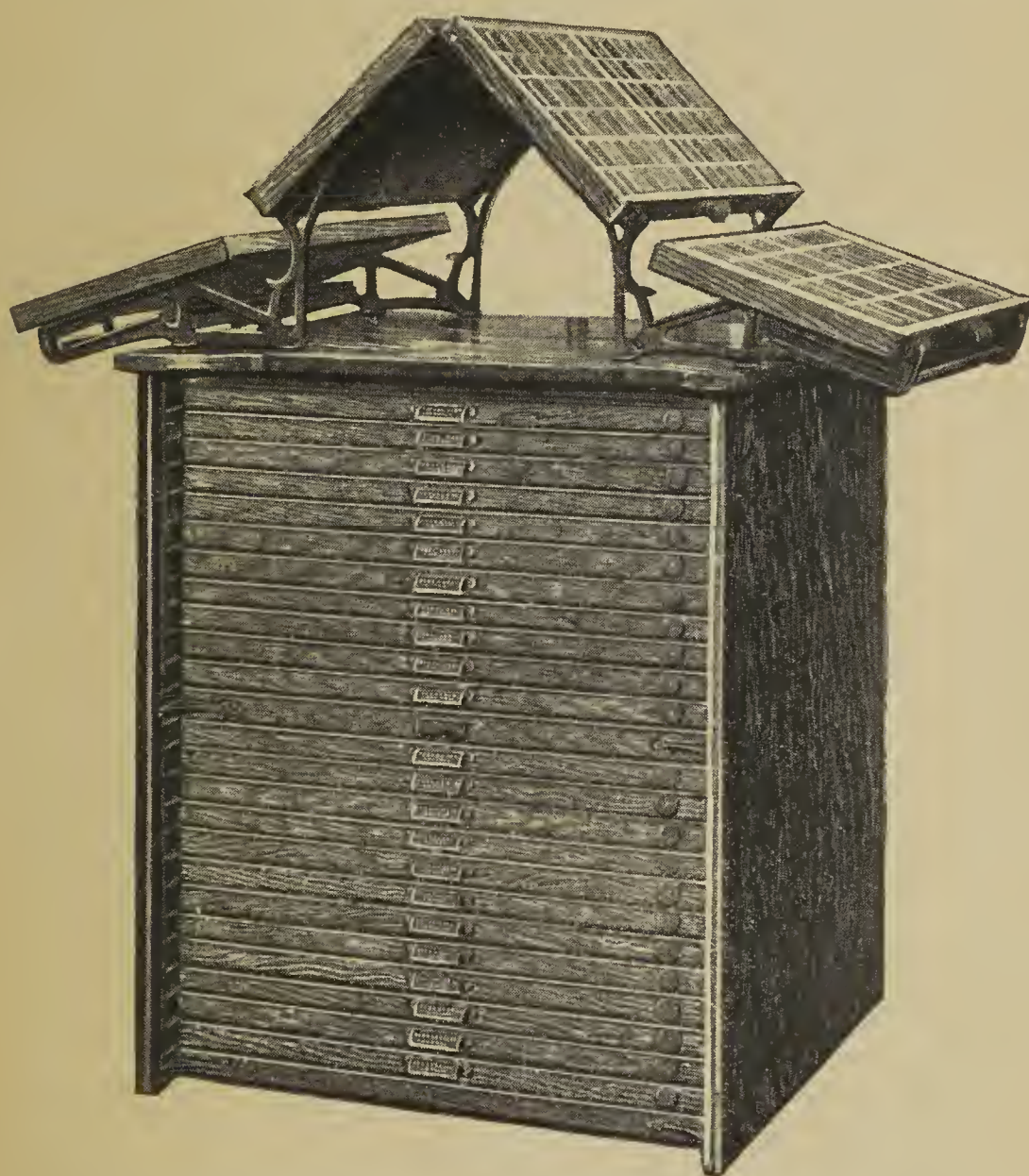
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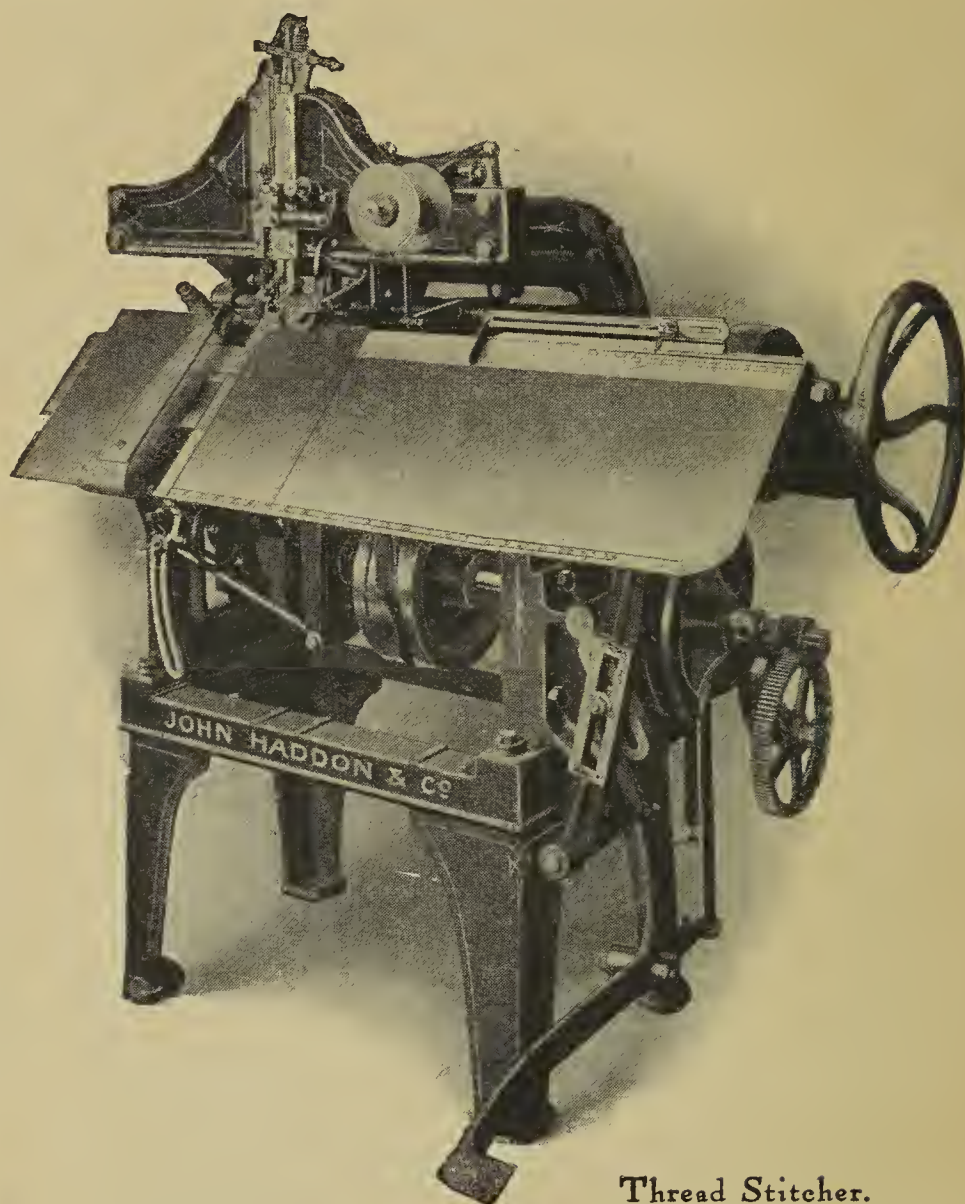


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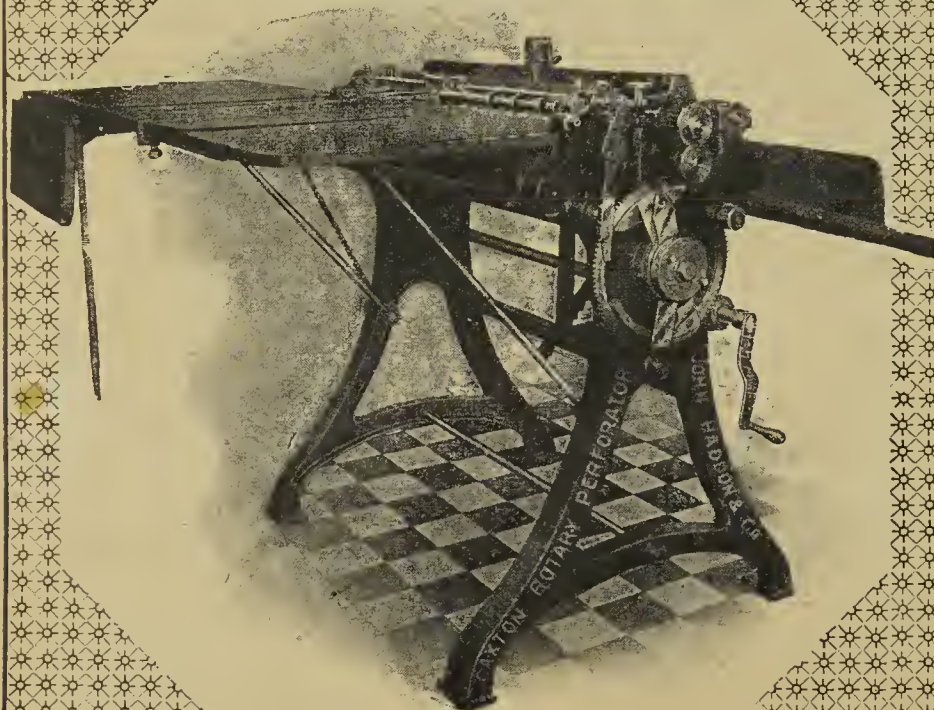
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A HANDBOOK

OF THE
PRINCIPLES AND PRACTICE OF TYPOGRAPHY
AND THE AUXILIARY ARTS.

BY

JOHN SOUTHWARD,

*Author of "Practical Printing"; "The Principles and Practice of Printing Machinery"; the Treatise
on "Modern Typography" in the "Encyclopædia Britannica" (9th Edition); "Printing"
and "Types" in "Chambers's Encyclopædia" (new Edition); "Printing" in
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THIRD EDITION.

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RAITHBY, LAWRENCE & COMPANY, LIMITED,

THANET HOUSE, 231-232 STRAND, W.C.

1913.

PRINTING 50 cent.

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PREFACE.

VOLUME II of "Modern Printing" represents a close revision of Sections III and IV in the earlier edition of this work.

The contents cover a wide range of subjects, designed, with the matter in Volume I, to give a complete work of reference to the printer and those interested in matters printerian.

The subjects discussed in this volume include press work generally and printing machinery, with chapters on job, book and colour printing, bronzing, embossing and gold printing.

The volume includes necessary references to the Auxiliary Arts which are more or less closely allied with printing, as, for instance, notes on paper, electrotyping and stereotyping, typefounding and process engraving. Warehouse operations, notes on wages and hours, apprentices, the City and Guilds Institute examinations, may be mentioned as covering other branches of information; whilst particular attention is paid to office management, costing and estimating.

As a revised edition of the work by the late John Southward, this volume represents the labours of many experts in their various departments of activity.

We would in particular recognize with most cordial thanks the assistance rendered by Mr. F. W. Lewis—

who was also closely associated with the compilation of the first edition—in numerous directions; the valuable work of Mr. Robert Grayson in the revision of many notes on printing methods; the ready and careful attention of Mr. E. B. Hanson (London Manager, Stephenson, Blake & Co.), typefounding; Mr. Harry Maddox, paper; Mr. E. H. Atkinson (Garratt & Atkinson), photo engraving; Mr. W. Ilston Cox (Shackell, Edwards & Co., Ltd.), inks and colours; Mr. G. F. Read (R. Hoe & Co.), rotary presses. Secretaries of trade societies, notably Mr. T. E. Naylor (London Society of Compositors) and Mr. H. W. Howes, have rendered valuable service, and to the technical class instructors—quite a number of whom have been of assistance in small but none the less important matters and with many hints and suggestions—we offer our thanks and warm acknowledgments.

“Modern Printing” to-day is the work not of one, but of many, and is confidently offered as a real book of reference to the members of a trade which is nothing if not intensely practical.

H. W.

October, 1913.

CONTENTS.

	<i>Page</i>
CHAPTER I.—THE HAND PRESS—MECHANICAL FEATURES AND WORKING	1
CHAPTER II.—PLATEN MACHINES—MECHANICAL FEATURES ...	20
CHAPTER III.—THE WORKING OF PLATEN MACHINES	34
CHAPTER IV.—THE WHARFEDALE MACHINE — MECHANICAL FEATURES	41
CHAPTER V.—MAKING READY ON WHARFEDALE MACHINES ...	57
CHAPTER VI.—MAKING READY AND WORKING WOODCUTS AND PROCESS BLOCKS	72
CHAPTER VII.—SOME TYPICAL CYLINDER MACHINES	87
CHAPTER VIII.—THE TWO-REVOLUTION MACHINE	97
CHAPTER IX.—WORKING THE TWO-REVOLUTION MACHINE ...	107
CHAPTER X.—AUTOMATIC FEEDERS	110
CHAPTER XI.—TWO-COLOUR AND TWO-FEEDER MACHINES ...	116
CHAPTER XII.—PERFECTING MACHINES—MECHANICAL FEATURES	119
CHAPTER XIII.—WORKING AN ORDINARY PERFECTING MACHINE	129
CHAPTER XIV.—ROTARY WEB PRINTING MACHINES	133
CHAPTER XV.—FLAT-BED WEB MACHINES	161
CHAPTER XVI.—ROLLER CASTING	167
CHAPTER XVII.—WASHING FORMES	180
CHAPTER XVIII.—PRINTING INK	183
CHAPTER XIX.—COLOUR PRINTING—SELECTION OF COLOURS	186
CHAPTER XX.—MODIFICATION OF COLOURS BY PROXIMITY ...	196
CHAPTER XXI.—PROPERTIES OF INKS USED IN COLOUR PRINTING	200
CHAPTER XXII.—COMPOSING AND MAKING READY FOR COLOUR PRINTING	205
CHAPTER XXIII.—PRINTING BLOCKS IN COLOURS	211
CHAPTER XXIV.—GROUND TINTS	216

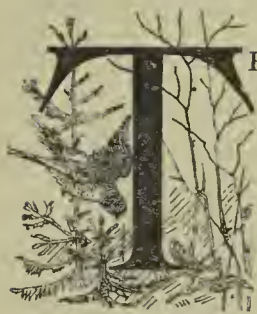
	<i>Page</i>
CHAPTER XXV.—THREE-COLOUR PRINTING	227
CHAPTER XXVI.—BRONZING MACHINES	232
CHAPTER XXVII.—EMBOSSING BY LETTERPRESS PROCESSES ...	238
CHAPTER XXVIII.—GOLD PRINTING	245
CHAPTER XXIX.—MANUFACTURE OF PAPER	252
CHAPTER XXX.—VARIETIES, ETC., OF PAPER	257
CHAPTER XXXI.—STEREOTYPING	266
CHAPTER XXXII.—ELECTROTYPING	270
CHAPTER XXXIII.—ARTS AUXILIARY TO LETTERPRESS PRINTING	274
CHAPTER XXXIV.—TYPE FOUNDING	285
CHAPTER XXXV.—PHOTO-PROCESS BLOCKS	294
CHAPTER XXXVI.—HINTS ON THE CARE AND PURCHASE OF MACHINES	299
CHAPTER XXXVII.—THE WAREHOUSE	303
CHAPTER XXXVIII.—THE LIGHTING OF THE PRINTING OFFICE	319
CHAPTER XXXIX.—COMPANIONSHIPS; DUTIES OF CLICKER; THE CHAPEL	328
CHAPTER XL.—APPRENTICES	331
CHAPTER XLI.—EXAMINATIONS OF THE CITY AND GUILDS OF LONDON INSTITUTE	337
CHAPTER XLII.—WAGES AND HOURS	347
CHAPTER XLIII.—ESTIMATING	359

MODERN PRINTING.

VOLUME II.

CHAPTER I.

THE HAND PRESS.—MECHANICAL FEATURES AND WORKING.



THE first Volume of this work is devoted to the composing department of the printing office—that wherein typographic surfaces are produced. There have now to be described the machinery and the methods whereby these surfaces are utilised for the purpose of making impressions.

Printing is defined to be “the act, process, or practice of impressing letters, characters, or figures on paper and analogous materials.”

The appliance or apparatus by which the impression is effected is called the press.

There are, broadly, two kinds of presses in use, the hand press and the machine press. In the printing office the hand press is spoken of as “the press,” and the machine press as the “machine.”

There is an essential difference between the two. The press can be worked only by hand power; the machine may be driven by steam, gas, or other motive power. The operation of printing by either involves a certain number of movements. In the press these are completed slowly. In the machine

they may be done at a high rate of speed, and almost automatically, by mechanical devices actuated by a single revolving shaft. The output of the press within a given space of time is limited; that of the machine is very considerable. To print a surface which is beyond a certain superficies is impossible at the press, because manual labour would be insufficient. Other points of difference between the two classes of appliances will be indicated as they are respectively described.

In America, and on the European continent, a large variety of hand presses are in use, and in their mechanical arrangements they differ greatly from British presses.

The three kinds of hand presses most generally in use in Great Britain are, the Stanhope Press (named after the Earl Stanhope, but of French derivation); the Columbian (invented by the American engineer Clymer); and the Albion (an adaptation of previous inventions made by an engineer named Cope). Of these the Columbian is in many respects the best, but in the land of its origin it has been superseded by the Washington Press, invented by the engineer Rust, and which is not manufactured in this country. An unusually strong press, the Reliance, is also in use for special purposes.

Each of these presses is made throughout of iron and steel with the exception of certain brass or other fittings.

The Stanhope Press, although very seldom to be seen now at work, is occasionally employed in pulling proofs. The Albion Press is chiefly used for light work. The Columbian, though less compact, is of stronger build, and is best adapted for jobs requiring heavy impressions, such as posters.

Principles of Hand Press Work. Although presses are now nearly superseded by platen and cylinder machines, a knowledge of their principles should be regarded as indispensable even to operators on the apparatus which have supplanted them. The principles of the hand press embody most of those of cylinder machines, with the exception of the cylindrical impression.

The type forme is laid on a flat plane called the bed of the press. In London this is often, according to ancient usage, called the coffin. The paper is pressed on the forme by another flat plane, called the platen. This latter moves vertically and presses the paper on the type. The two are

the essential parts of the hand press. The power necessary for this movement is obtained in a variety of ways as will be shown presently.

Each time an impression is taken the forme has to be inked, after which the paper to be printed is laid upon it. As this operation, together with that of removing the printed sheet, could not be conveniently done if the forme were stationary below the platen, the forme table is mounted on a carriage running on two rails so that it may be brought under the platen and withdrawn from beneath it for inking and laying on. This backward and forward motion is effected by turning a handle connected with two bands. For further convenience in applying the paper accurately to the forme, the sheet is laid, not directly upon the type, but upon a kind of leaf hinged on to the carriage. This leaf is called the tympan. The paper is laid on it to marks or gauges, when it is in an almost upright or vertical position. This ensures the paper being printed in the exact position required. The tympan is a thin frame of metal, over which parchment or cambric is stretched. It is double, in order to contain inside a certain quantity of "packing" such as blanketing or paper, which moderates the force of the impression of the platen.

The ink is applied by a cylinder or "roller" covered with an elastic composition, about half an inch thick, of glue and treacle, or of glycerine or other substances. This cylinder is mounted in an iron frame with handles, and is capable of revolving freely. On an iron table placed for convenience near the press the ink is spread out in a streak by the aid of a palette knife or other tool. By bringing the roller up to this streak it becomes roughly coated with ink. This coating has to be regularly "distributed," however, in an extremely thin film, over all the cylindrical surface of the composition. This is done by causing the roller to revolve repeatedly over different parts of the surface of the table. The roller is then applied to the surface of the type forme on the press table, and moved in different directions over it until sufficient ink has been transferred to the forme. This is called rolling the forme. Such process forms a very important part of press work. If insufficiently performed there will be too much ink on the impression, or even

blotches, or technically “monks”; or the impression may be too pale or grey—imperfections in the way of under-rolling being called “friars.”

The sheet of paper to be printed is next laid on the tympan, being adjusted to pins which serve as guides to the proper position. The tympan is then folded down on the forme with the right hand, while with the left the handle is turned, causing the press carriage to be brought under the platen. A long lever connected with the platen attachments, called

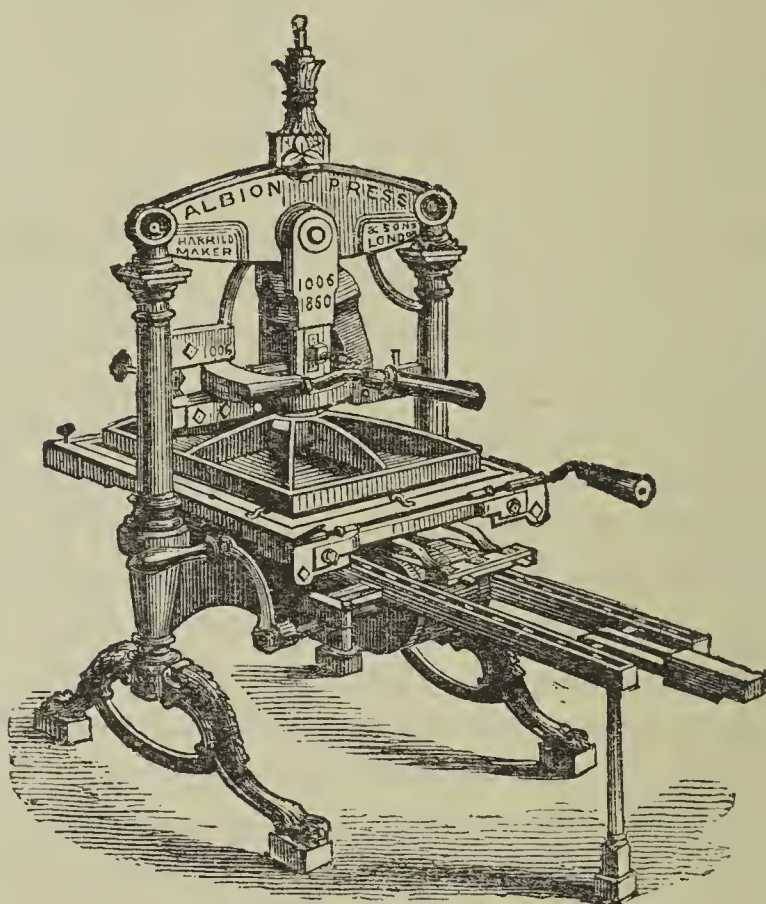


FIG. 1. ALBION PRESS.

the bar, is pulled with the right hand, the handle turned the reverse way with the left hand and the carriage brought out again. The tympan is then raised and the printed sheet removed.

This is a mere outline of the operation of printing at each of the iron presses already named. Their principal differences, as mentioned, consist in the manner in which the platen is depressed, and the degree of impression obtained.

How power is obtained. The Stanhope Press has a heavy cast-iron frame in one piece, screwed to a wooden foundation

called the cross. The descent of the platen is caused by a screw worked by a peculiar combination of levers, so arranged as to act with progressively increasing force until the platen reaches the types. A movable slot regulates the range of the handle and consequently the pressure exerted on the types.

The platen of the Albion Press is mounted on a strong iron frame with a cross piece or head. Connected with this is a piston which, moving up and down, propels the platen. The power is gained by causing an inclined bar of steel to

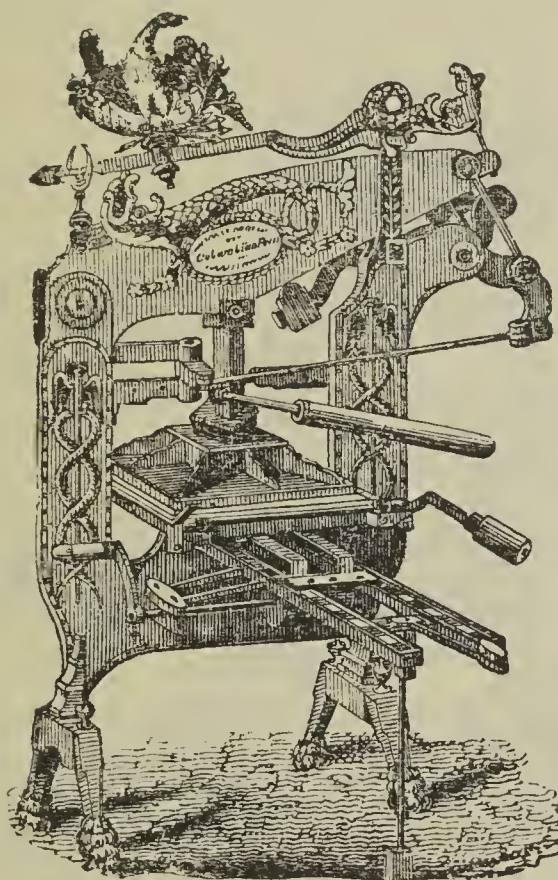


FIG. 2. COLUMBIAN PRESS.

become perpendicular in the direct line of pressure. In doing so the platen is forced down. This steel bar is the "chill," shaped like an elbow. At one end is the bar, already mentioned—a handle which being pulled toward the operator straightens the chill or brings it into the vertical position. At the sides are guide plates, or guides fixed into the frame to preserve the parallelism of the platen, for the slightest vibration or lateral movement would prevent a clear, sharp impression being taken—in other words would cause slurring. There are appropriate appliances, such as a helical spring,

fixed on the head of the press, whereby the platen is raised when the pressure is not required.

In the Columbian the power is gained by an ingenious combination of levers. Two of these are connected by a rod with the handle. The platen is hung on a bolt sliding between vertical guides and is counter-balanced by a lever having an adjustable weight, shaped like an eagle, which raises it automatically. In the bar handle is the screw stop by means of which the length of the rod of the lever can be adjusted and its pressure or the "pull" varied.

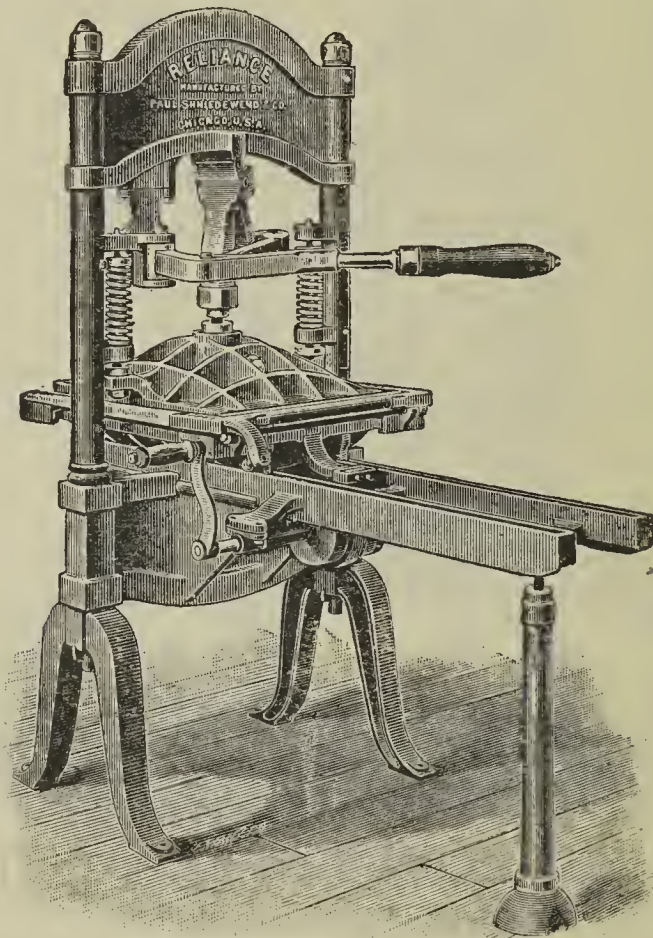


FIG. 3. RELIANCE PRESS.

The Reliance Special Hand Press, an American invention, is designed and specially constructed with the view of withstanding the great strain necessary in proving large half-tone and other blocks, for which purpose the Albion and Columbian presses are not sufficiently strong. Numerous breakages have occurred, usually across the pillars under the head of the press staple. In the Reliance Press the toggle lever and connections are of forged steel, and proportionately to other

presses have been much enlarged and strengthened. The leverage is also increased. The frame is made in four sections, and these are secured by heavy steel rods running through them, the upper ends of which are secured by solid heads with wide flanges and the lower ends by lock-nuts. Being thus made in sections, the strain, which would otherwise be all or partially on the forme, or columns, is thrown entirely on the steel rods.

Covering the Tympan. Various materials are used occasionally for covering tympan. Parchment, however, is undoubtedly the best. Tympan made of cambric soon become loose, or baggy, and the work done by their agency may become slurred. A very fine, clean, sharp impression cannot be obtained from a coarse linen tympan, the fabric being coarse enough to render its use apparent in the impression.

Assuming that parchment is used, the process of making the tympan is best carried out as follows :—

Thoroughly soak the parchment by placing it in water for some time previous to the actual covering of the tympan.

Strip off the old tympan. Thoroughly cleanse the frame by washing it. If it does not become quite dry the dampness will assist the adhesion of the parchment.

Wring out the parchment to liberate the excess of water. Lay it on a flat surface, such as a wooden board or a smooth slate. It is not desirable to use the imposing surface for the purpose, for the wet skin of the parchment will cause the metal to rust, and this spoils the appearance of the tympan. Most printers like to have for the latter a perfectly clean, unstained surface.

Now lay the tympan frame on the parchment. Most probably it will be too large and require to be cut down, for only enough of the parchment should be turned over as will be sufficient to keep it adhering to the frame.

Cut holes in the parchment, through which the tympan hooks can be passed. This will provide a foundation for the work and enable the operator to stretch the parchment as may be found necessary.

Paste, for an inch or so in width, all round the skin. The edges may be cut into two or three inch sections, but the cuts must not extend beyond the edge of the tympan frame.

The object is to allow the skin the more completely to adapt itself to the frame.

At points along the surface of the frame the skin will need to be cut to accommodate the frisket nuts, etc. The corners of the skin must also be cut off squarely, so that joinings at the corners will be neat and not bulky.

Now turn the pasted edges of the skin over the frame, stretching as tightly as possible. If the edges are likely to protrude too much towards the centre of the tympan, pull it up again and cut away more of the skin. No more parchment should be left than is necessary to cause it to adhere tightly to the frame. Turn over and tuck in carefully. When thoroughly stretched over, trim at the corners and put the tympan in a safe place to dry.

If tympanans are constantly in use it is convenient to cover them on a Saturday, so that they may be thoroughly dry on beginning work on the following Monday morning. It is well to cover on a dull, damp day, for if it be satisfactory in regard to tightness in that condition of the atmosphere, it is sure to be satisfactory in warm, dry weather.

When the covering is completed, the tympan may be improved if the centre parchment is rubbed over with a clean wet sponge.

Materials used: Parchment, and some good bookbinder's paste. Gum or glue is not suitable; these set too quickly, and do not allow the operator time to stretch the parchment sufficiently. The cutting of the skin is best done with a pair of shears and a sharp penknife.

Tympan parchments are cut to sizes and sold by dealers in printing materials. The sizes correspond to those of presses, from post folio to double demy, and larger sizes. Tympan cambric is supplied in lengths of so many yards, forty inches in width.

The Frisket. When fine presswork has to be done there is attached to the upper part of the tympan a "frisket." This is a light rectangular iron frame, covered with brown paper, about the size of the tympan frames. It serves a double purpose, first in keeping the paper to be printed close to the tympan, and next in preventing the paper being blacked by the furniture, or other parts of the forme with which it

should not come into contact. The parts of the frisket which would cover the printing surface when the frisket is over the forme are cut out. The pressman first folds this frisket over the tympan and then turns down the latter before running in the carriage. Pieces of cork, called bearers, are also sometimes placed at intervals on the frisket for the purpose of preventing smearing of the sheet.

Cutting out a Frisket. The iron frame is laid on a table and a piece of strong brown paper fastened to it by pasting the edges in the same way in which a tympan is covered with parchment. The frisket is then fastened to the tympan by the small catches provided. It is next turned down on the tympan, the forme inked, and an impression taken. On being removed from the tympan and again laid on a table the parts which have been impressed are cut out with a sharp penknife. This must be done carefully, for if any portions are left to intervene between the paper on the tympan and the forme, those portions will prevent the latter being printed, or “bite.”

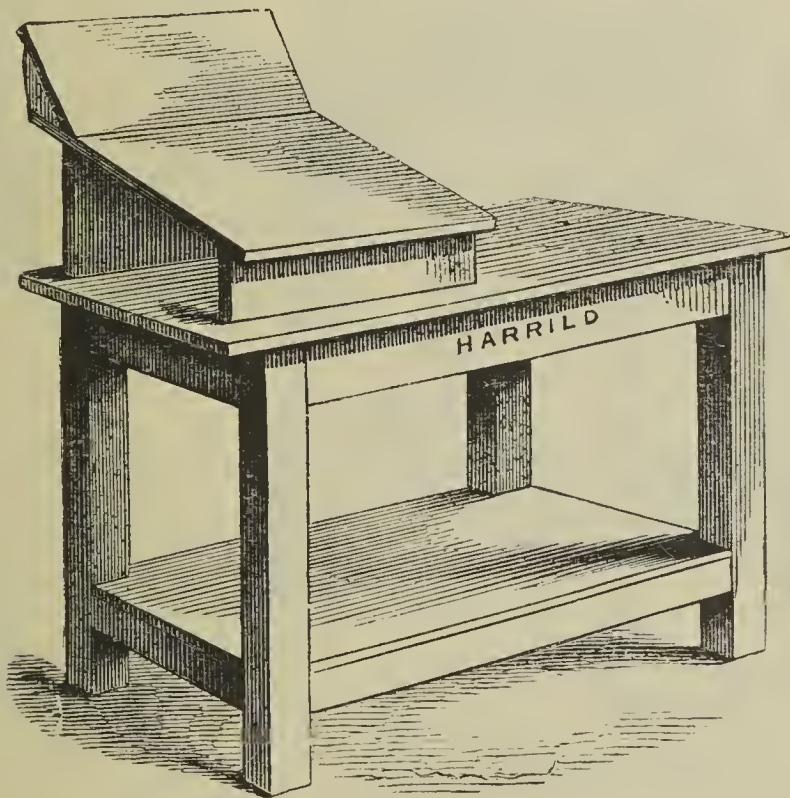


FIG. 4. BANK AND HORSE.

The Bank and Horse. The “white” paper—that is, the unprinted paper, whatever its colour—is kept on a kind of sloping desk called a horse, about 2 feet 2 inches long and

20 inches wide, standing at an angle of about 30 degrees, 6 inches of it at the back rising more perpendicularly. The horse is mounted on a bank, which is a deal table between 3 and 4 feet long, 22 inches wide, and 3 feet high. On the part not occupied by the horse the printed sheets are laid in a pile, as worked off.

The Ink Table. At the off side of the press—that is, the opposite side to that from which the handle extends—is placed the ink table. Its arrangement on the other side is not convenient.

Various forms of ink tables are used. A plain wooden table, of substantial construction, with a smooth wooden top, may be used for the purpose. It will be improved if a slab of polished slate is laid on the top, as the ink will not then sink into the wood.

The brayer ink table is entirely of iron, its shape being shown in the accompanying illustration. It derives its name

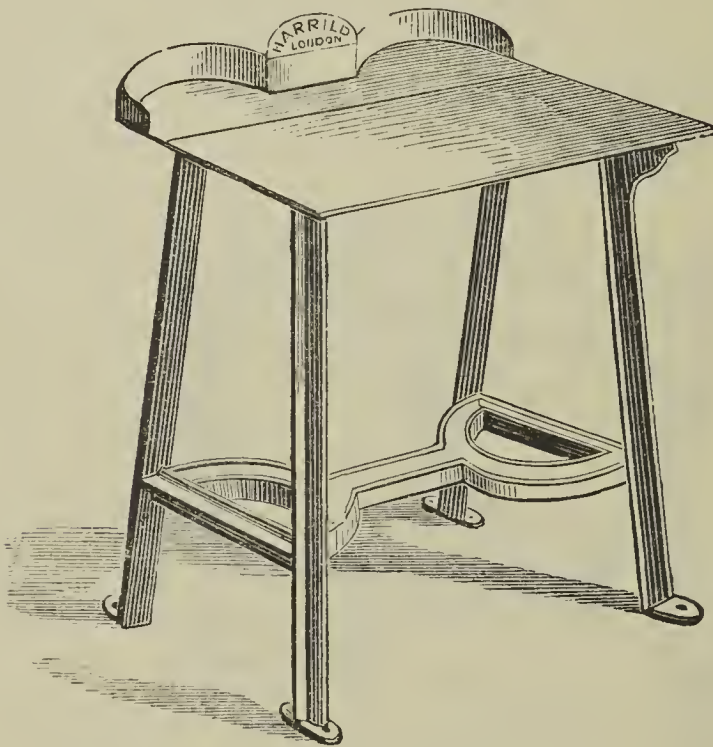


FIG. 5. BRAYER INK TABLE.



FIG. 6. INK BRAYER.



FIG. 7. INK SLICE.

from the brayers used with it. These are made of wood, and are of the shape as shown. The projections at the back of the table are for holding brayers. Another appurtenance of the table is the ink slice (Fig. 7).

When the brayer is used, a portion of ink is taken out of the can with the slice, and laid on the back of the table. With the brayer this ink is spread across the table in a fairly even streak, an inch or two wide. The roller is then brought up to the nearest edge of the streak, and afterwards the ink is distributed over the rest of the table by the roller being repeatedly moved backwards and forwards, as already referred to. A cylindrical ink table is made, which saves the trouble of using the brayer. The ink is placed in the receptacle

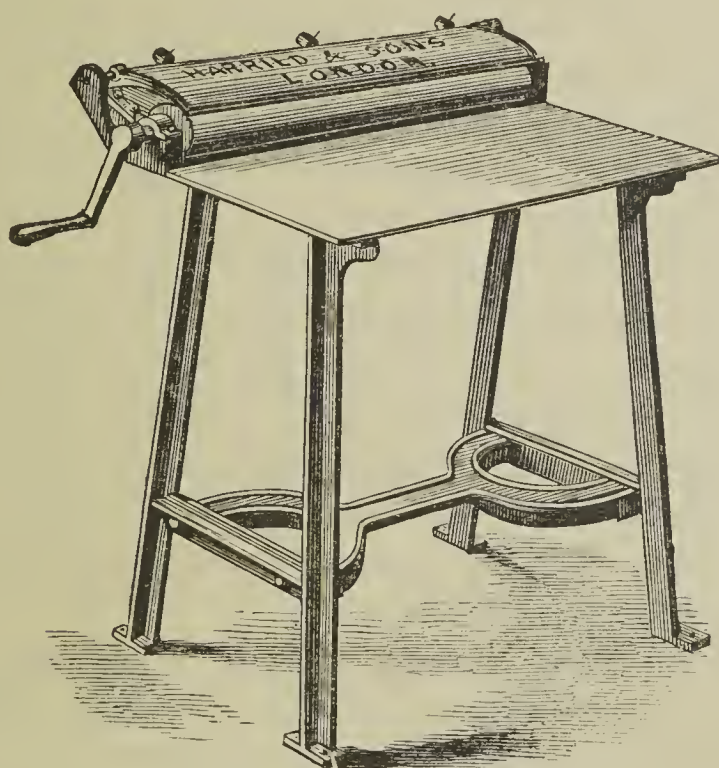


FIG. 8. CYLINDRICAL INK TABLE.

shown at the back, which is fitted with a movable cover. The cylinder is turned by means of a handle. The roller is merely brought up to the cylinder, and then distributed. The advantages are that the ink is kept free from dust, etc., and the trouble of braying out is avoided; on the other hand, cleaning the cylinder when a change of ink is necessary is somewhat troublesome. Many printers prefer the simple brayer table. Ink tables are made of various sizes, proportionate to the size of the press.

WORKING OF THE HAND PRESS.

The manipulation of the press includes inking the roller and inking the forme; laying the sheet on the tympan; folding

the tympan on the forme; running the latter under the platen; taking the impression by depressing the platen, and raising it afterwards; running out the forme, lifting the tympan, taking off the sheet and depositing it on a table or "bank." Some of these are in themselves complex actions, such as the rolling, which involves a knowledge of how to apply the proper quantity of ink at a time, in order that all the sheets of one job may show the same density of colour; how often to roll the forme before taking more ink; how heavily or lightly to apply the roller; how to increase the rolling where it is needed, as when there are engravings, or how to avoid depressions such as the margins of pages. The other duties of the pressman include (1) the making of tympan; (2) cutting out friskets; (3) making rollers—although these are now usually bought ready made; (4) washing rollers; (5) keeping rollers in order; (6) preparing them for work; (7) selecting the right kind of ink for the work in hand; (8) making ready the forme; (9) wetting paper—although dry paper is now generally in use.

Before beginning to work off a job, it should be ascertained whether the press, the tympan, and the forme are in a state of perfect cleanliness. All grit and dirt should be removed from the bed of the press, and the back of the forme brushed over with a dry brush.

Care must be taken also to remove the make-ready, overlays, etc., of any previous job from the tympan, and especially see that all the pins are taken out. Remains of paste and so on must be carefully removed with a wet sponge.

Position of the Forme. The forme is placed in the middle of the press table. The distance from the tympan hinges to one side of the chase and from the edge of the bed next the platen to the other edge of the chase being equal, the forme is in position in one direction. There is a nick on the front edge of the platen as a guide for centring in the other direction.

Centring is not, however, always possible, and in that case bearers—to be referred to presently—must be used. The platen must have an equal resistance at its four corners, otherwise the type will not be equably printed.

The forme is then fastened on the bed. If it be a large one, quoins only will be necessary for the purpose; if smaller, quoins, a sidestick, and furniture; if very small, empty chases

may be used by putting one on each side and locking with quoins against a sidestick.

The use of "locking up" chases saves much of this trouble. They fit the bed of the press, and have on two sides a rack. Bars are provided which drop into the rack close up to the forme, and a quoin is sufficient to secure the whole.

The position of the chase of the forme should be marked with a lead pencil before it is fastened up. This is to provide against the necessity of lifting it at any time, when it can be replaced in exact position without trouble.

Putting on the Tympan Sheet. A sheet of the job to be worked has now to be taken and laid on the forme in exact position. The back of the sheet being slightly damped, an impression, without ink, is taken. It will adhere to the tympan, but must be secured there by pasting it at the corners. Pins are put in—two at the longer side and one at the shorter—to act as guides for laying the sheets.

Packing the Tympan. The packing used between the tympan frames in hand presses may consist of blanketing (which is made in four qualities, thin fine, fine, medium stout, and stout, and in lengths, about 29 inches in width), india rubber blanketing, broad cloth, soft or hard paper, cardboard, etc.

No specific rule can be laid down for the selection of these materials. The principle usually followed is that solid book pages, masses of small type, placards with wood type, require the softer kinds of packing; whilst open work, such as headings, circulars, formes with rules, etc., should have hard packing, which will give a more delicate and sharper impression than soft packing. If the type is worn the blanket is most suitable.

It is of importance to use the lightest and thinnest kind of packing that will produce the required effect. The closer platen, forme, and paper are brought together, the sharper and more perfect will be the printing. In addition the register will be more easily maintained.

A very light impression may now be pulled on a sheet of paper. The forme is inked by the roller—the revolution of its cylinder during the action of moving it backward and

forward giving it the necessary coating of ink. The tympan is next turned down on the forme with the right hand. The handle of the rounce is grasped with the left hand. Turning it in a left-hand direction brings the carriage under the platen. Care must be taken not to bump it against the stops at the end of the ribs. The bar is then pulled, which brings down the platen ; after the impression is given, the bar is pushed back, and the platen, aided by the spring or counterpoise in the head of the press, returns to its ordinary elevation. With the left hand the rounce is turned to the right, causing the carriage to run out. The tympan is lifted, and the printed sheet removed.

The first impression from any forme should be pulled very lightly. If this impression is unduly heavy, the tympan may be cut, and some of the kerned letters in the forme broken. The impression should, after several trials, be gradually increased until a suitable degree is obtained.

Pressure is varied at the hand press in different ways, such as by lengthening or shortening the levers attached to the handle, or by the impression screw in the front of the Albion Press. These have been already mentioned. As little impression as possible should be used, provided that the most satisfactory results are obtained. If too much pressure is put on, the impression will be thick and coarse, whilst the type will be ground down and perhaps broken ; if too light, some parts of the print will not appear at all.

Making Ready. However accurately the proper pressure is applied, the forme will not—except the whole of the type and material is new, and of perfectly uniform height to paper, which are conditions seldom met with—print properly. Some parts will be lower than others. Various parts, too, will require more pressure than others, and some less, such as brass rules. These necessities are met by the process of “making ready,” which consists in so levelling the surface of the forme that every part of it will receive an equal impression when the platen is pulled down. This is effected by “underlaying” or “overlaying.”

Underlaying consists in levelling the surface of the forme by placing thicknesses of paper under the parts that are low. If this were not done, these parts would not receive sufficient

ink from the roller, and the other parts would receive too much ink. Overlaying consists in placing pieces of paper over certain parts of the forme, which if not thus treated would give too weak an impression. Generally speaking, large type and the darker parts of woodcuts and blocks require overlaying, because more pressure is required to print them properly than to print small type. The difference of pressure is obtained by the overlay. Making ready will again be referred to in dealing with platen and cylinder machines.

The forme is then lifted for underlaying. Pieces of paper, cartridge, wrappers or cards, as may be required, are cut to the required size, pasted, and stuck on underneath the parts that are low. The forme is then replaced on the bed of the press, the quoins slightly loosened, and the forme planed down. Another impression is then pulled for overlay purposes. The sheet is placed face downward on the horse, or on a sloping board, when the inequalities at the back can readily be seen in a good light. Where the type is high, as is shown by undue pressure, the sheet containing that part is cut away. Where the impression is too light, the part is "patched" with thin pieces of paper, which may be torn or cut out with a knife, and pasted on the sheet. This patched sheet may now be temporarily placed on the tympan exactly in the same position as that in which it was pulled, the print exactly corresponding with the types. A white sheet is placed over it and pulled, and any imperfections noticed and dealt with as before. This is continued until a perfectly satisfactory impression has been obtained.

The patched sheet must be accurately placed inside the tympan, so that the overlays will fall exactly on the lines they are intended to bring up. One plan of doing this is as follows:—Pull the tympan sheet, and fasten it in its proper place. Then take off the inner tympan, and remove the packing. Run four pins, each from one corner of the impression, through the tympan from front to back. The patched sheet may be placed on these pins, which serve as a guide to the exact position. The pins being removed, the packing and inner tympan are replaced.

Bearers. If the forme is small, compared with the size of the platen, it is advisable—in order to save undue wear of

the type, and to get a sharp yet delicate impression—to place near the four corners of the bed “bearers,” in order to resist any excessive pressure of the platen. These bearers may consist of anything that is type high, such as a large wooden or metal letter turned upside down, or pieces of cork cut to the proper size, or suitable strips of wood. Mechanical bearers are made, consisting of a block of wood the height of furniture, with a helical spring in the middle, which projects a little beyond type height. The action of this is to reduce the pressure of the platen.

Bearers are necessary for all jobs which have blank spaces at one side, such as a three-page circular, one of the pages of which is blank ; or a sheet of book-work which has short outside pages, the open spaces being made up with furniture, quads, etc. The platen does not at these parts encounter the same resistance as when coming into contact with type-high matter. The equilibrium of the platen is, therefore, disturbed, and certain parts receive too much pressure and others too little. This has to be counteracted by the judicious use of bearers. Where much rule work is found in a job bearers are also necessary to prevent the tympan being cut. If of wood they may be stuck down by melted roller composition or fish glue ; or by pasting a piece of paper to them, and then pasting the same paper underneath in order that it may adhere to the bed.

Register. If a leaf of a well-printed book is held up to the light it will be seen that the lines of one page—provided both pages are of the same length—fall exactly upon those of the other. This exact agreement is called the register. The word is also applied to the accurate printing of two colours one over the other, and to similar preciseness of position in jobs embodying successive workings.

Pointing at Hand Press. Register is obtained in hand press work by the use of press points. These are long, thin pieces of iron shaped as shown in the diagrams. At one end is a pin or spur. The point is fastened to the tympan frame by a point screw.

There are several kinds of points. Some have a spring attached to the blade, as shown, and these are useful in partly lifting the sheet after it is printed. It will be noticed that the

8vo and the 12mo points differ in shape. The paste point differs from both. It is pasted inside the tympan. The spur points are also placed there. The "common" points are of the same shape as the 8vo and 12mo respectively, but have no spring. When these appliances are placed in position the spur projects above the outer tympan. The sheet is laid on the latter, and when it receives the first pull it is perforated by the points. The points are so adjusted, as will be mentioned presently, that when the second side has to be printed, if the holes in the sheet fall exactly on them there will be proper register. The sheet is not thus laid to its edges, as when ordinary work is done; if it were, and there were any discrepancy in the size of the sheet the register would be thrown out.

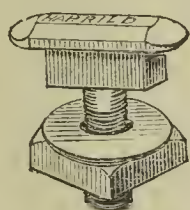


FIG. 9. POINT SCREW.

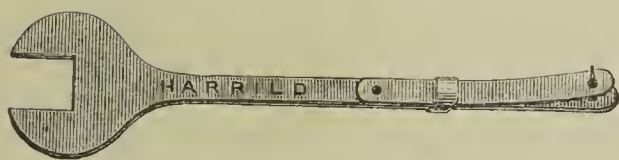


FIG. 10. 8VO SPRING POINT.

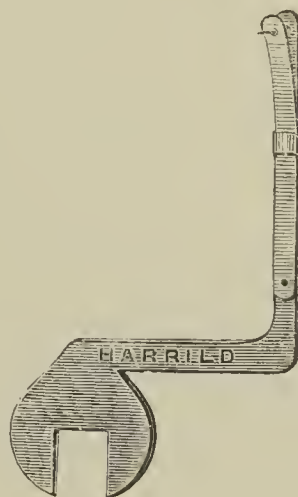


FIG. 11. 12MO ELBOW POINT.

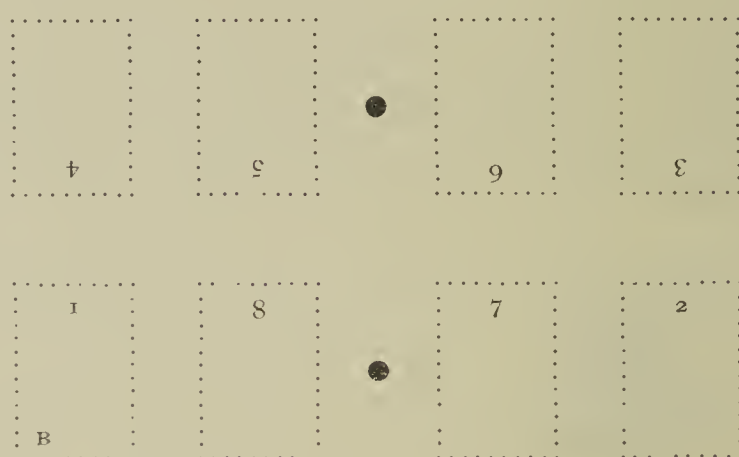


FIG. 12. PASTE POINT.

The proper position of the points is shown by the dots in the diagram of an 8vo form of book-work.

The points are fixed to the point grooves at each side of the tympan frame by the screws as mentioned. They have to fall over the grooves in the bars of the chases or otherwise would obviously smash the type wherever it came under them. They must also be in the middle of the sheet, otherwise when turned for working the other side the pages would be thrown out of register. The octavo and similar chases

permit of a straight point being used, as one bar comes in the middle. The chases of formes of the 12mo size are different, and there is no bar in the middle. Hence the use of the elbow point as shown (Fig. 11). It may be screwed to the central tympan groove, and its shape allows of the point falling over the 12mo bar. The points for the forme referred to would be placed between pages 7 and 11, and 6 and 10, and 14 and 15.



Paste points are used when the other kinds cannot be made use of, and are pasted inside the tympan (hence the name). Drawing pins are sometimes used for the purpose. Great care must be taken that these are—whether pins or paste points—properly secured. Spur points are also placed between the outer and inner tympan.

The frisket has to be prepared next if a book-work forme is being worked. The frame is covered with paper, like the tympan. The forme is rolled, and a light pull taken on the paper of the frisket. Those parts which are printed upon must be cut out, so that they may not intervene between the type and the sheet to be printed. The working off of the forme can then be proceeded with.

In printing at the hand press, two men are usually employed. One of them rolls the forme; the other lays on the sheet, pulls, and takes off the sheet.

Great care must be taken in rolling if all the sheets are to preserve a uniformity of colour, and the pressman should from time to time compare the last sheet printed with one of the first ones, when any deficiency or excess can be seen.

It is important also to examine an impression occasionally to see whether “picks” have made their appearance. These are small blots or patches caused by fragments of the roller becoming loosened and adherent to the forme, or bits of paper, fluff, etc. Should they occur, the matter must be removed from the type by means of a pick brush.

Slurring. When the paper is slightly shifted after it has come in contact with the type it becomes smeared by the ink, and the impression will lack that degree of clearness and sharpness which is a characteristic of good printing.

This defect may arise from a variety of causes, chiefly dependent on the condition of the press, amongst which are the following :—

The press being out of order. The platen may move sideways when the pressure is put on ;

The looseness of the bolts connecting the platen with the piston ;

The looseness of the screws of the tympan frame ;

The platen not being level or properly adjusted ;

The guides not pressing against the piston ;

The foundation of the press not being firm or level.

Too thick or improper packing of the tympan. If the packing is “baggy” slurring is sure to result.

Slurring may also arise from other causes. Bearers, consisting of thin slices of cork pasted on the frisket, often remedy cases of slurring.

Setting Off. If the second side of the sheet is worked off before the ink on the other side has had time to dry, a part of it will attach itself to the tympan sheet and “set off” on the back of the next sheet that is printed. To prevent this, set-off sheets are used. They consist of sheets coated with something that will not absorb the ink, such as oiled paper, paper coated with glycerine, turpentine, etc. From time to time it may be necessary to renew these. The pressman must always bear in mind the danger of set-off, and examine the sheets occasionally with that view.

CHAPTER II.

PLATEN MACHINES—MECHANICAL FEATURES.

IT may be said that platen machines now in general use are distinguished by trade names which identify their manufacturers but do not indicate their principles or special features.

These machines have features common to all, but some of them possess improvements of their own, adapting them for particular classes of work. The original inventor of the small platen machine was Geo. F. Gordon, an American. His machine, called the Franklin Press, was brought over to England and manufactured for many years by the Croppers, a firm of engineers, who re-named it the Minerva. Hence it has since been known as the Cropper or the Minerva machine. This style of machine is largely used for light ordinary work, but later machines have been adopted when greater strength, speed, and rolling facilities are required. The Cropper being the prototype of the class requires to be noticed first.

In the hand press, as already pointed out, the forme is laid on a horizontal table or bed, and is rolled along the ribs until it is brought under a horizontal platen, which, descending, produces the impression on the paper beneath it. In the ordinary platen machine a different principle is adopted. The type-forme is placed in a vertical position, and when the platen is brought into contact the paper between them is impressed. The vertical principle of the machine as compared with the horizontal principle of the press, reduces the amount of labour involved to one-tenth, whilst permitting of an output ten times as great, as some of the motions are automatic and the apparatus may be driven by treadle or by power.

The Cropper machine consists of two side frames held together by iron stretchers. To these frames all the working

parts are connected. The back part consists of a bed into which the forme is fitted, in a perpendicular position. Over this is the inking apparatus. The front part consists of a platen lying at an angle of about 45° when stationary. The sheet is laid to pins or gauges of some kind on the platen, which is pulled forwards towards the forme by two strong steel arms, one on either side, and this action causes the impression. The platen returns to its original position and remains so sufficiently long to enable the operator—usually a boy (often known as a “Cropper hand”)—to take off the printed sheet with his left hand, and lay on another sheet with his right hand.

Inking Arrangements. In small machines there are two composition rollers, or inkers, and one distributor. The latter receives its ink from a “duct” constructed as will be described when dealing with cylinder machines. The inker distributes the ink over the ink plate, which is a disc, and may be in two or more parts revolving in different directions, in order to facilitate the distribution. The two inkers travel on bearers down the front of the bed, in the course of which movement they ink the forme. This is done while the machine is open and the layer-on is removing one sheet and placing another in position.

These motions are effected as follows:—The shaft bears upon its extremity a small spur wheel, which works a large cog wheel. To this latter is attached a strong steel rod, connected at the other end with a frame which works loosely upon fixed bearings. The rollers, generally three in number, are fitted into forks in a frame. The movement of the latter is effected by the revolution of the large wheel holding the steel arm. The perpendicular travel of the rollers is caused by strong springs attached to the fork which pull the inkers flush with the surface of the forme, allowing them to run again on to the almost flat ink disc on their return. For this purpose the rollers are fitted with flat wheels, running on guides. The latter ensure steady motion and support, and prevent a roller from being damaged by undue pressure.

Feeding Arrangement. Running round the edge of the platen are two wrought iron bands, which are hinged in the centre and may be lifted up separately. When closed down they act like clips, to secure on the platen the packing,

corresponding to that in the press, but which is therein placed between the outer and inner tympan. The sheet of paper is secured to the platen in its descent by two flat pieces of steel or gun-metal, about ten inches long, three-quarters of an inch wide, and one-eighth of an inch thick. These act like

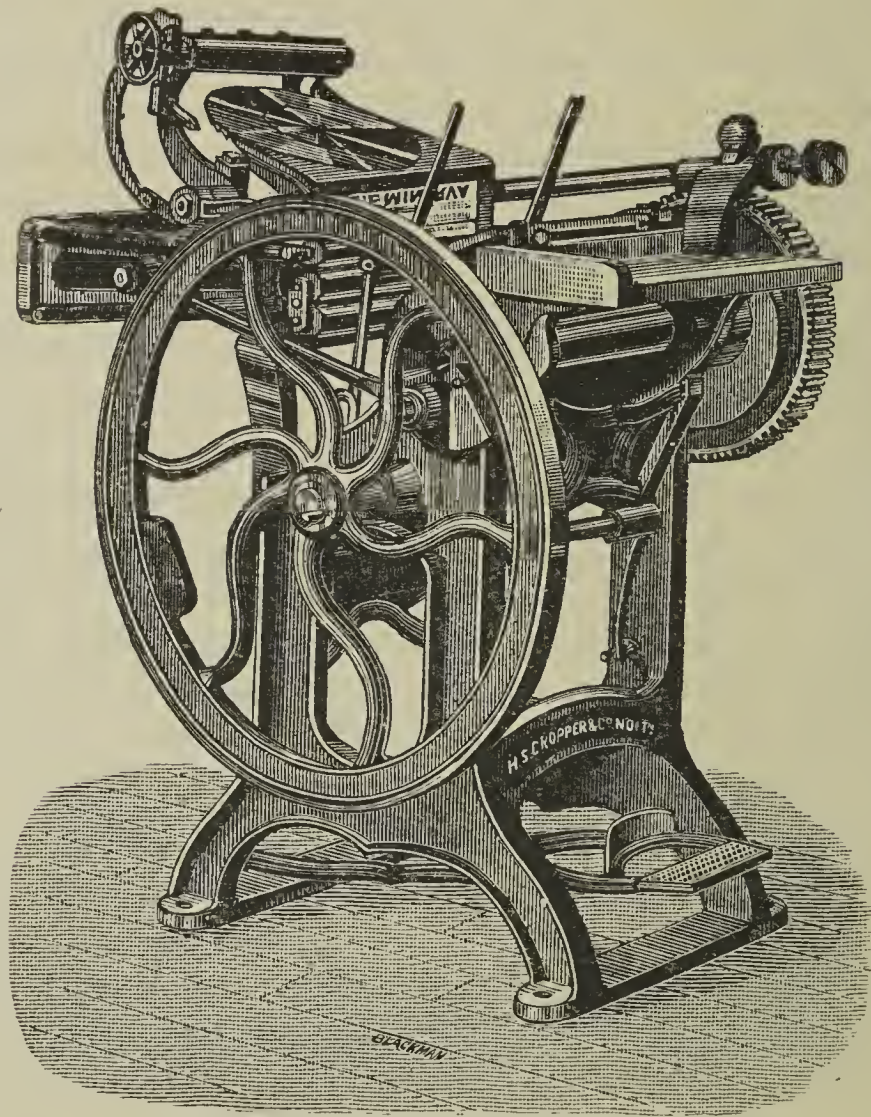


FIG. 13. THE CROPPER PLATEN MACHINE.

fingers, opening at one time and closing at another—that is, when the sheet has to be kept firmly down. They are operated by a stationary cam, fixed on the side frame, and as the platen goes down they mechanically close on the paper. For convenience of adjustment to different sized sheets, they can be moved along a gripper bar from side to side.

Regulation of Impression. The forme, locked up in the chase, is fastened to the bed by a chase catch, which is made to release its hold instantly when the forme has to be removed. Behind the platen at the four corners are four screws, which

enable the platen to be perfectly levelled, so that at the proper time it will be precisely parallel to the bed. When the machine is adjusted for level impression, these screws do not require alteration. The degree of impression is varied by a screw acting on a rod which is conveniently placed at the right-hand side of the layer-on. This rod is connected with an eccentric shaft at the back of the machine, and thus varies the pressure on the forme.

All good machines of this class are provided with a useful contrivance called a "throw-off." This stops the impression by arresting the motion of the platen. It allows of the ink being run up while the forme is in position, and prevents a badly laid sheet from being spoiled. The throw-off in the Cropper machine is put in operation by turning to the left a knob attached to the end of the impression rod, which has already been mentioned. Other machines bear different devices for the same purpose.

The whole operation of printing, except the supply and removal of the sheets, is done automatically by the machine, which, in the absence of power, may be driven by a treadle.

The Cropper, or Minerva, is a compact and simple machine but deficient in certain qualities which are essential when the best kinds of modern printing are attempted. Hence the attention of printing machine engineers has been directed to securing greater strength of impression, increased inking and distributing power, more convenience in making ready, and a higher rate of output.

The Improved Franklin (Cropper, Charlton & Co., Ltd.,) is made on the Cropper principle. The framework is cast in one piece and fitted with special ink duct and distributing roller. Other new features are : the supply of ink from the duct can be varied without stopping the machine ; the ink feed can be varied or stopped automatically, according to the variation or throw-off of the impression, there is a distributing roller which passes only over the ink disc, and three inking rollers, all of which pass completely over the forme ; a flexible steel knife with adjusting screws is applied to the ink duct and allows of varying amounts of ink being supplied to different parts of the forme for printing two or more colours at one impression ; the ink cylinders can be lifted entirely away in

such a manner that the knife and cylinder can be easily cleaned and the cylinder put back into its place without the necessity of adjustment.

The latest addition is the *Double Check Motion* which has for its improvement a connection on the left-hand side of machine. This connection is coupled to the adjustable

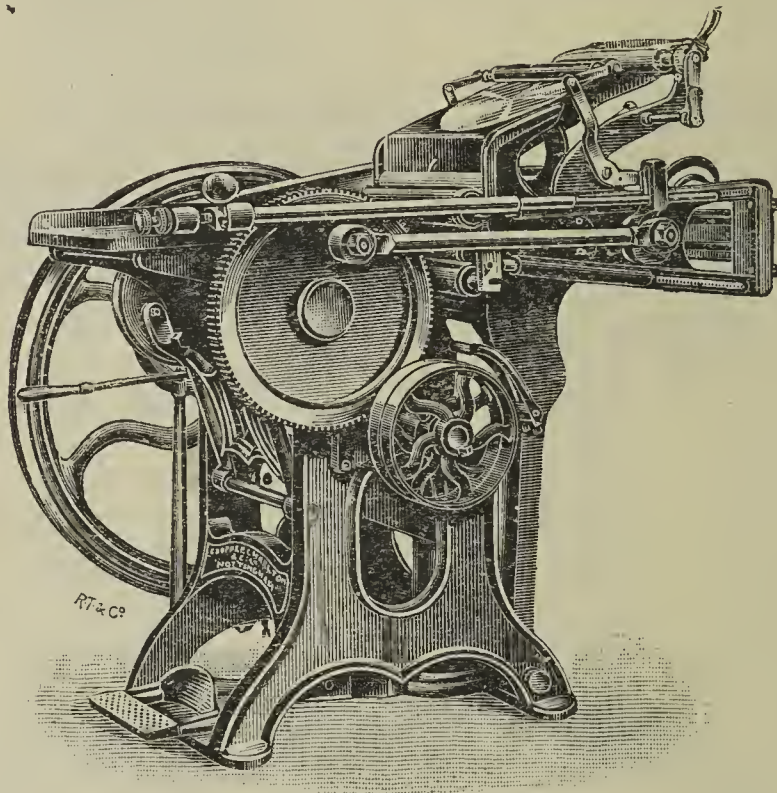


FIG. 14. IMPROVED FRANKLIN PLATEN MACHINE.

impression rod on the right-hand side of machine. The arrangement enables the operator to check on either side and is a simple, but a very desirable addition to this machine.

As examples of modern platen presses mention may be made of the following machines :—

THE ART CAXTON PLATEN.

The Art Caxton Platen is a British-built machine constructed with cylindrical inking and parallel approach of platen to type bed. It is extremely strong, and intended not only for the highest grade of letterpress and colour printing, but also designed to cope with heavy work such as embossing, carton cutting, plate marking, etc., all of which can be advantageously carried out upon this class of machinery. The impression is obtained by the impact of a moving platen upon a

stationary type bed. This moving platen is a single heavy casting, and it rolls upon suitable supports until it is absolutely parallel with the face of the type, when it moves inwards with an absolutely square impact.

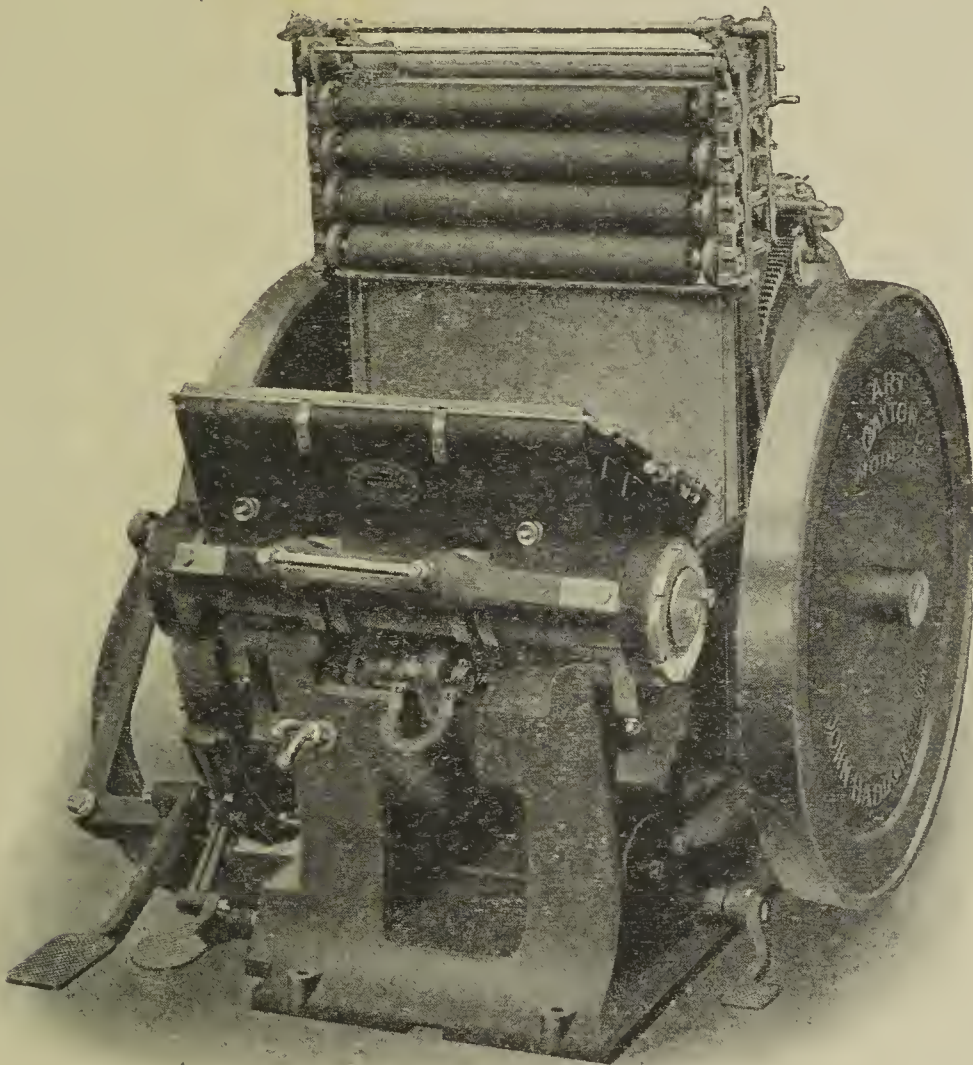


FIG. 15. CANTON PLATEN, MODEL C.

The framework of the machine is a single massive casting of great strength and stiffness, of which the type bed forms an integral part. The platen is also a single heavy casting, and surfaces of both platen and type bed are not only planed true, but are hand scraped to Whitworth surface plate standard, so that there is a perfect impression over the whole of the forme. Both platen and type bed are backed by heavy steel shafts accurately ground and these are joined by massive side arms of best wrought steel and rectangular

section. These side arms are designed to withstand a breaking strain of 100 tons. The shaft at the back of the type bed is furnished with two massive gears, one at each end, which carry the crank pins upon which the side arms work. Most machines are furnished with a flywheel on each side. It is claimed for this method of construction that torsional stresses in the shaft at the back of the type bed are eliminated and the press will do better work and last longer.

The inking arrangements are designed to cope with the most exacting conditions, and are successively elaborated in different models. In all models there is a powerful distributing system above the forme. The ink supply is governed by a flexible steel knife capable of fine adjustment, and is thoroughly broken up by means of a succession of composition and steel distributing rollers which charge two large reciprocating distributing drums. These drums charge four large inkers which measure $2\frac{3}{4}$ inches in diameter in the three best models, these inkers being interchangeable with the distributors. The inkers work upon adjustable tracks, so that their pressure on the forme can be easily regulated, and the models which are furnished with a single inking system have their forme rollers so arranged that certain of them are held in reserve as the roller carriage travels downwards, and these come into play while the roller carriage travels upwards, thus ensuring that the forme is inked with fully charged rollers from each side. In a more elaborate model there is a more perfect arrangement still. In this machine, known as Art Caxton Model A, there is not only a powerful inking system above the forme, but below the forme there are three reciprocating distributing drums. All four inkers are in contact with the forme on the downward travel of the roller carriage, and when these reach the bottom of their stroke the ink left upon them is thoroughly worked up and equalized by the three drums below the forme, so that they are practically freshly charged when they travel upwards again. Model B is more elaborate still, for this machine is furnished with a duplicate ink duct and distributing system below the forme, so that when the rollers reach the bottom of their travel they are completely recharged, and the forme is therefore double rolled.

Besides these main features the Art Caxton Platens have a special device which is of great value when the press is used for the double purposes of printing and embossing. This is what is called a "two-position platen," and by means of this device it is an easy matter to increase the platen opening by $\frac{5}{32}$ of an inch above type height without disturbing the impression latch blocks. This increased platen opening is necessary to admit of the introduction of a thick force when embossing with type-high dies. It is useful when printing book covers and it is also extremely valuable for carton cutting, as it allows of the face of the platen being protected by means of a thin plate of brass or mild steel.

The Caxton is made in two sizes, namely demy and demy folio, and at the time of going to press a crown folio machine of this type is being put on the market under the name of the Caxtonette.

THE GRIPPER FED PLATEN MACHINE.

The Haddon Safety Platen may be instanced as a typical example of this class of machine. It is made in one size only, namely, demy folio, and arranged to run at speeds of from 2,500 to 3,000 impressions per hour. Its distinguishing characteristic is the fact that the platen is quite stationary and forms part of the massive casting constituting the main frame. The type bed is movable and is pulled into contact with the platen by means of a pair of side arms in the ordinary way. The sheets are fed down a sloping feed board to disappearing gauges and are taken by a gripper bar which carries them to the printing position. When this is reached they are further held in position by frisket fingers and are not released either by the gripper bar or by the frisket fingers until printing is finished. They are then taken by the delivery grippers, which carry the sheets to the back of the machine where they are kept in a neat pile by means of a sheet jogger. Make-ready is effected by making the platen face removable so that it can be lifted away complete with tympan frame and sheets.

The inking arrangements upon the Haddon Safety Platen are an elaboration of the inking apparatus introduced with the Golding Jobber. The supply of colour is governed by a

flexible steel knife, and the fountain roll is of extra large diameter. The fountain is full length and a full length vibrator takes the colour from the fountain roll in the form of a thin broad film and distributes it upon a rotating ink disc, from whence it is taken by means of three inkers working upon adjustable tracks. The impression trip is controlled by means of a conveniently placed treadle and can be operated at any time without danger. The slope of the machine is so arranged that the sheets travel through the press in practically a straight line which makes it possible to print thick cards without bending them.

THE STERLING.

This machine is made in demy folio size. The main body of the machine is one strong box casting with which the type bed face, platen supports and main bearings are incorporated. The platen is cast in one piece, and is fitted with turned steel shaft, depressible grippers, and adjustable feeding gauges which are very simply adjusted. The impression is adjusted by two segments (one each end of the platen, usually only one segment is used by other makers on this size machine), which can be set to the greatest accuracy. The impression check is made in a very substantial manner and is very easily operated. The ink distributing drum has a lateral movement and is fitted with distributing and steel rider rollers. The ink duct is fitted with steel knife and regulated by adjusting thumb screws. The levers are made either in wrought-iron or cast-steel, the shafts and connecting link are steel forgings. Altogether a serviceable and well-made machine.

THE ACME PLATEN.

Of foolscap folio size, this is specially useful for jobbing work and has a dead dwell on the impression with the platen securely supported by an approved locking device. The impression can be regulated by means of an adjustable check apparatus with ease. The machine is fitted with three inking rollers and one distributing roller which pass over the ink disc. The duct is fitted with flexible steel knife and adjusting screws, and the cylinder can be turned up from the knife for easy cleaning, depressible grippers, adjustable

feeding gauges and steam gear with brake fitted. The machine is run by power.

PARAGON PRESS.

The No. 2 Paragon Press, size 11 × 7 inches inside chase, is typical of a machine designed for small high-class printing. The type bed is cast along with the main standard in one piece. Roller bearers are adjustable. It is fitted with ink duct with flexible steel knife. The cylinder can be raised for cleaning. It has three inking rollers and one distributing roller. The grippers are depressible, the impression can be checked at any time by a very simple and easy movement. The machine is strongly built and runs very smoothly by treadle.

The most popular class of platen machine for half-tone work, three-colour and the heavier class of printing, is illustrated in the notes on the Caxton Platen. Also widely in use are the Phoenix, the Victoria, the Colt Armory, the Conqueror and others. We have described one of the foregoing machines in some detail as affording desirable information on platen machines, required not only by the buyers but by users.

It may be added that platen machines are made in various sizes. Where power is used the demy folio, crown and even demy sizes are more or less popular. Treadle machines are usually in royal octavo (7 × 11 ins.), foolscap folio (9 × 13 ins.), crown folio (10 × 15 ins.), demy folio (13 × 19 ins.), royal folio (13 × 20 ins.). These sizes are inside measurements of the machine chases.

Protectors for Feeders. A variety of appliances have been invented for the purpose of preventing accidents to feeders, who carelessly or otherwise may fail to lift the hands before the platen reaches the bed, and thus get them crushed. The Factory Act includes provision for protection to workmen operating machines which is held to apply to platen presses, and all platen machines must be equipped with a guard to protect the hand of the feeder. Practically all the makers of these machines attach a guard as a matter of course, and, although there are a few special and patented appliances adjustable to most makes of platens, more or less automatic in action, each of the engineers making machines of this type

has devised his own suitable form of guard. The invention usually consists of a contrivance whereby the motion of the platen automatically thrusts up the hand out of the way.

Automatic Delivery. Several machines are now provided with appliances which render taking off unnecessary. The Falcon and Koh-i-noor platen presses made by Waite & Saville, Ltd., Otley, may be instanced as examples.

The Phoenix Platen Machine is manufactured by Messrs. Schelter & Giesecke, Leipzig, for whom Messrs. Wesselhoeft & Zimmermann, Farringdon Avenue, London, E.C., are sole agents.

The Falcon Safety Platen Press. This machine, patented and manufactured by Waite & Saville, Ltd., Falcon Works, Otley, embodies the features of an ordinary platen with the addition of a safe, Wharfedale feed and self delivery. The principal object is to eliminate any danger to the feeder and, at the same time, greatly increase production. The machine is claimed to yield more than double the output of any other platen, as the operator is relieved of the taking-off. Nearly three-fourths of the time occupied by the whole operation is available for feeding, and both hands are at liberty for stroking in the sheet.

The sheets are fed on the flat on a feed table with adjustable gauges, and are thence taken, printed, and delivered—printed side up—without the aid of tapes or flyers, thereby obviating the risk of smearing. The feed table is detachable, and can be lifted off, leaving the platen fully exposed and accessible from all sides. The necessity for sticking quads, etc., on the platen is dispensed with, as the metal gauges on the feed table can be readily adjusted in a few seconds.

A novel arrangement on the type bed enables the operator, by means of a small hand wheel, to move the forme up or down to the desired position and there lock it.

The inking arrangements are easily controlled. Three rollers of large diameter, deriving their supply of ink from a circular distribution plate, pass twice completely over a full forme. The circular plate is charged from an ink duct, which can be regulated without stopping the machine to pick any number of teeth, from Fig. 0 to Fig. 6, thus allowing it to be controlled with great nicety.

In regard to register, the platen is brought to rest to receive the impression on a broad seating or shoe, and any variation is impossible. The sheet is taken from the feed-plate by the platen itself, no intermediate carrying mechanism being employed.

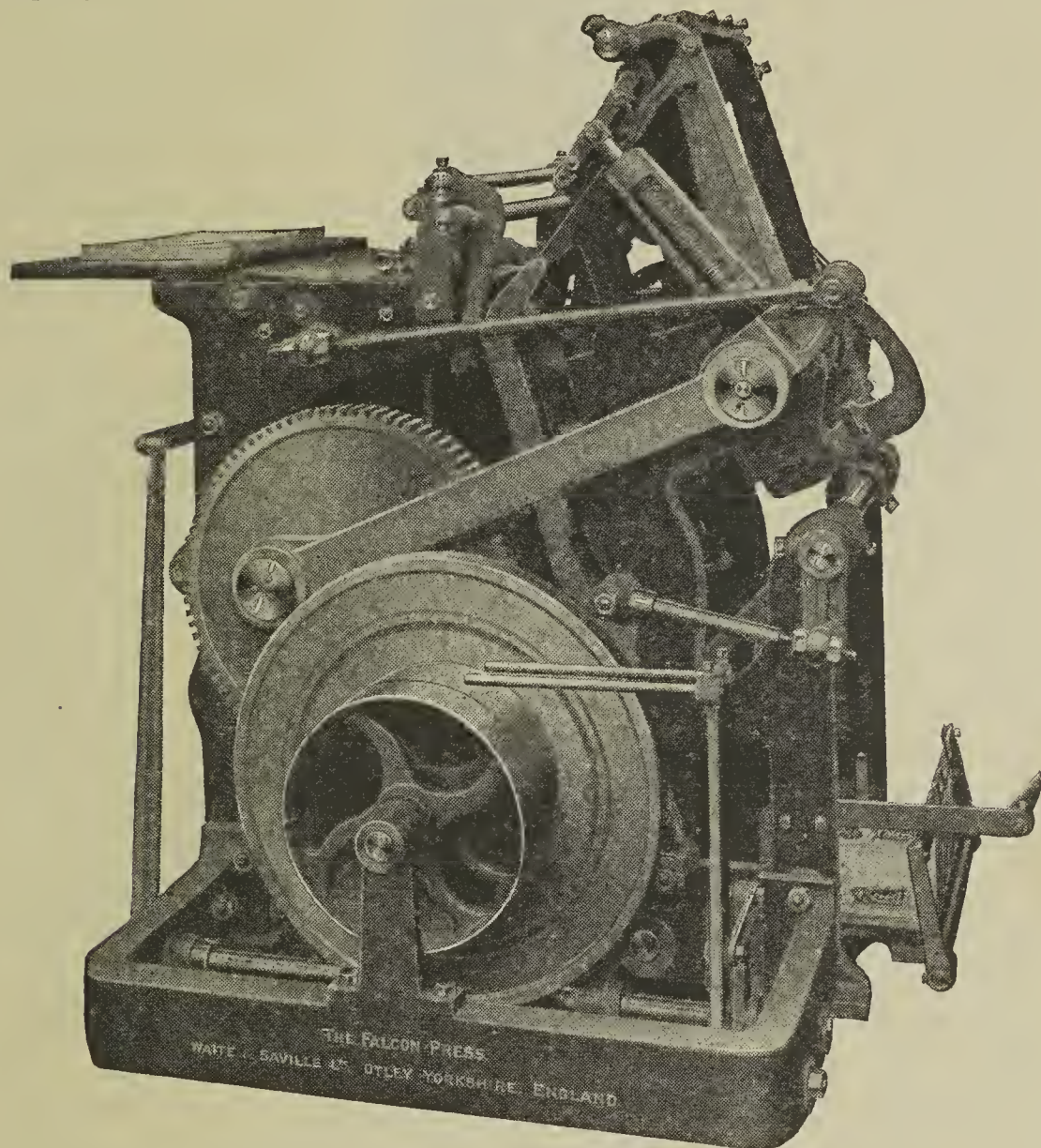


FIG. 16. THE FALCON SAFETY PLATEN PRESS.

After being printed, a set of grippers, mounted on a swinging gripper shaft, lays hold of the sheets, takes them to the delivery board, and there deposits them in a pile, printed side up, without risk of smearing. It delivers a full-sized sheet or a visiting card, no adjustment being required.

The *Express Falcon*, to print a sheet $10 \times 6\frac{1}{2}$ inches, is the smallest size made, and this press fitted with detachable automatic envelope feeder runs at a very rapid rate. For

printing ordinary stock the automatic feeder can be replaced by the ordinary feed table in one minute. The makers claim this to be the fastest platen in the world.

The impression is firm and rigid. Instead of the ordinary plan of driving a platen press by a spur wheel and pinion at one side of the same only, the Falcon has large spur wheel and pinion at both sides, thus having double the driving power, giving equality of impression, and longer life. The platen is operated by a new method, and its construction obviates the necessity for the type to be in the centre of the bed—the printing can be done equally well with the type at edge of platen as in the centre. This arrangement renders slurring impossible.

The inking arrangements are ample and easily controlled. Three rollers of large diameter, deriving their supply of ink from a circular distribution plate, pass twice completely over a full forme. The circular plate is charged from an ink duct, which can be regulated without stopping the machine, to pick any number of teeth, from 0 to 6, thus allowing it to be controlled with nicety. There is an automatic double rolling motion, which checks the board and the impression at the same time. By turning over a small lever the inkers pass completely over the forme four times for each impression.

The platen is brought to rest, to receive the impression, on a broad seating or shoe, and any variation in register is impossible. After being printed, a set of grippers, mounted on a swinging gripper shaft, lays hold of the sheets, takes them to the delivery board and there deposits them in a pile, printed side up, without risk of smearing. The check, which is situated in a handy position for the feeder, is entirely novel. It acts silently, without bump or jar, and cannot be thrown in or out of action at the wrong time.

The Koh-i-Noor Small Job Press, patented and manufactured by Waite & Saville, Ltd., Otley, is intended chiefly for printing envelopes, post cards, tickets, and similar work, which cannot be printed in sheets and cut up afterwards. On the ordinary platen, the operator has both to feed and remove the sheet, thus entailing risk to the feeder, and also keeping down the output.

The sheets are fed on a polished steel plate, on which are

mounted front and side gauges (similar to an ordinary Wharfedale), and are thence taken by grippers, printed, and delivered with the printed side up. Immediately the tail end of one sheet is drawn off the feed table another can be

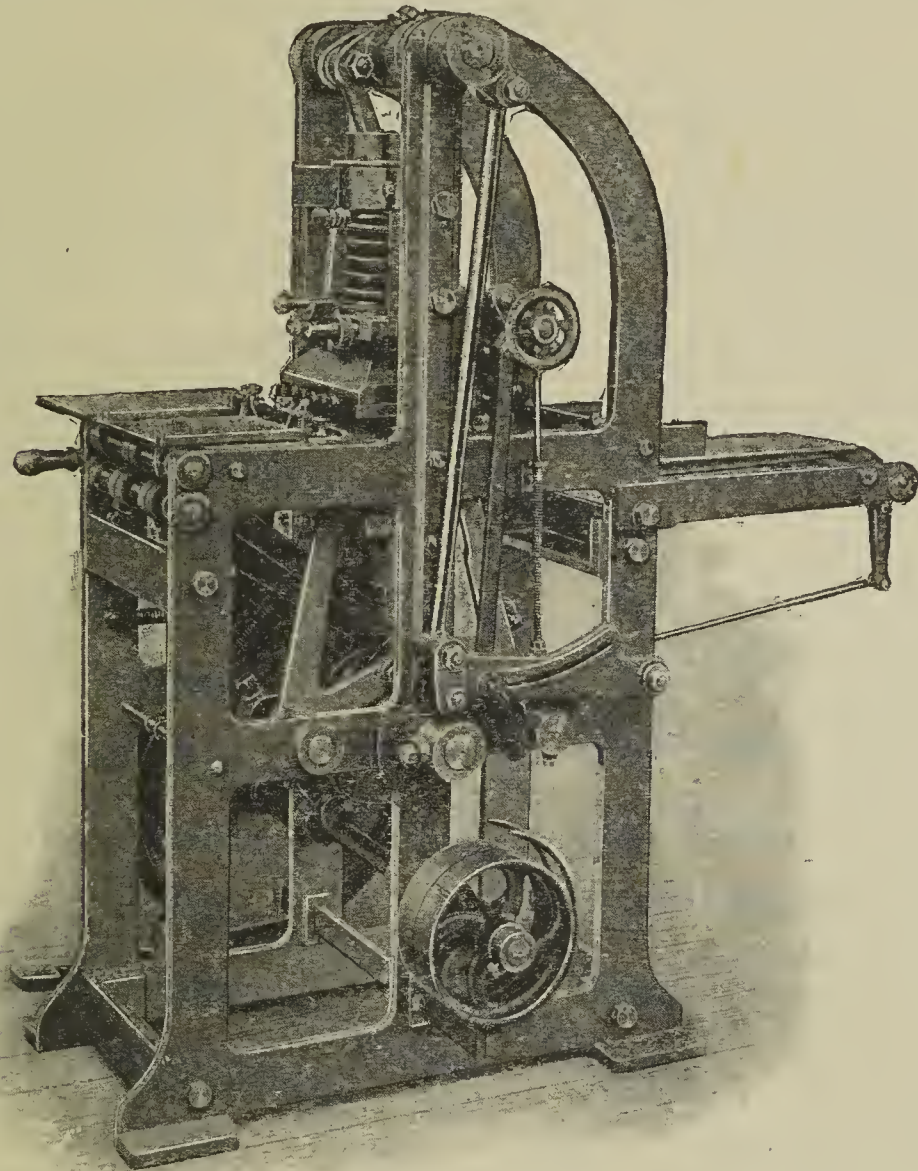


FIG. 17. THE KOH-I-NOOR SMALL JOB PRESS.

pushed forward to the gauges. This, together with the construction of the feed table and gauges, permits of very quick feeding, as it leaves nearly three-fourths of the time occupied by the whole operation available for feeding. The speed claimed is 4,000 per hour. The inkers are charged by a revolving ink cylinder, upon which is mounted a distributing roller with a lateral movement. This cylinder receives its supply of ink from a small ink duct, provided with means to regulate it to take one or more teeth as may be desired.

CHAPTER III.

THE WORKING OF PLATEN MACHINES.

Making Ready Type Formes. The following is the usual procedure for an ordinary job in movable type, such as a circular :—

First see that the bed is clear and free from dirt, and the ink duct, distributing surface, and rollers are perfectly clean. If not, they should be rubbed over with a piece of rag or waste soaked in turpentine or benzoline, and then wiped dry with a piece of rag. The rollers are next placed in position, and with an ordinary palette knife a little of the colour it is intended to use is spread upon the ink table, and the machine set running. This is termed “inking up.”

Packing the Platen. Take one or two sheets of fairly stout printing paper—say 54-lb. double crown, or its equivalent. Fasten them beneath the bottom clip, and then place next to the platen a thin sheet of cardboard, and add two or three sheets of paper ; draw the tympan sheets tight and firm, and secure them under the top clip in the usual way.

Of course, if the type is much worn, softer packing should be used. The board can be dispensed with, and additional sheets inserted.

The forme is next examined to see that all the quoins are tight, and that nothing is loose ; that the chase is not springing ; that it is properly planed, and that no foreign matter adheres to the back. It is a prudent plan to brush the back and to plane again.

If everything is correct the forme is fixed in the bed. A proof may now be taken on a waste sheet with a very light impression. This will enable the machinist to ascertain the requisite amount of pressure to be obtained by means of the impression screws. These are regulated until a solid impression is obtained.

All rule joinings, low rules, letters, blocks, or ornaments

should be brought up by careful underlaying. The necessity for this will be seen on examining the back of the proof. The underlaying may be done by removing the forme and pasting pieces of paper below the low type, and thread under the low rules. When this is finished, the quoins are loosened and the forme planed down again.

The forme is now replaced and an impression pulled, with a view to the overlaying. The impression may be taken on the tympan sheet, on which are patched up all battered and worn types, and all portions of the forme which are still low. If there are any blocks in the forme which require overlaying the overlays may be also fixed upon this sheet.

Another and better way is to pull an impression on a sheet pasted level with the top and right-hand corners of the platen, or pierce impression and tympan sheets with bodkin. On being removed and placed in a good light the defects will be apparent. High parts of the forme are cut out of this sheet and weak places brought up with paper of various thicknesses. The object to be kept in view is to produce a clear, sharp, uniform appearance, with as little impression as possible showing at the back of the paper.

If the impression has been made on the tympan sheet, a sheet of paper, pasted at the top and bottom edges only, is fastened over the whole. If the other plan is adopted the top band is loosened and the overlay placed next to the platen, taking care to fix it exactly in the position in which it was pulled—that is, to the top and right-hand side—or register impression sheet to bodkin mark. Another sheet is pulled, and if any further alteration or correction is required, the top clip is released, the tympan lifted, and the necessary correction made, without disturbing the overlay sheet.

The feed gauges are now adjusted. This may be done by measurement as follows: a sheet of paper of the proper size is taken, and the right side edge is placed on the impression showing on the platen, so that the whole of the margin will be on the left-hand side. This can easily be divided in half by turning back that part of the sheet, and fitting the gauges to the half of the total margin thus obtained. The same must be done for the bottom gauges.

In regard to gauges some difference of opinion exists.

Probably the best gauges for jobs in several colours, requiring accurate register, are pins or “patent gauges.” The following is a diagram of two of the more useful of them, as supplied by the Model Printing Press Co., Ltd.:—



FIG. 18.

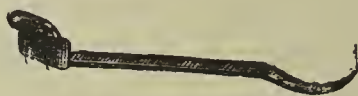


FIG. 19.

Many pressmen use pica quads, fixed on the tympan sheet by elastic glue. The danger of using quads is, that the constant “sliding home” of the sheet wears either the glue or the tympan sheet away, until the quads lift, and allow the sheets to slip underneath. This may be avoided to a great extent by pasting a narrow strip of thin card on tympan sheet alongside the quads.

To ensure that the gauges are properly set, a sheet is backed. The side gripper fingers are then brought up into position. If any slur or crease shows, some of the remedies to be mentioned presently are adopted.

An impression is taken on a “sheet of its own,” and after getting it passed by the overseer, ink is put in the duct, and the duct screws adjusted to give the proper supply. Working off is then proceeded with.

If, instead of a single page, there are four pages in one forme, a different plan is adopted for adjusting the gauges. When one side of the sheet is printed, the side gauge is removed from the left side, and placed on the right-hand side. This will secure register, even if the sheets vary in size. If, however, the job is one of two pages in one forme, the two inner pages are imposed with the heads downward, with the side lay to the side of page 2. When this forme has been worked off, the outer pages would be put on and made ready, but the side gauge would be to the right instead of the left. That is, the sheet would be fed to the same edges and at the same places for both formes.

If, in working the second side, the ink of the first working is found to set off, a sheet of oiled tissue pasted on the tympan, or an occasional dusting of the tympan sheet with french chalk, will supply a remedy.

Feeding a Platen Machine. Two methods of feeding may be recommended—one for small jobs, such as cards and 16mo sheets, and the other for sizes beyond these.

Whenever possible, the sheet should be fed with the broadest edge to the bottom of the platen, as this is the more certain way of obtaining good register.

As before stated, gauge pins are the most handy and economical for general work. Two will be used for the bottom or broad edge of the sheet, and one for the side. The position of the pins must be governed largely by the amount of margin there is to the work. In cases of narrow margins, it is often necessary to arrange for the tongue of a gauge pin to fall in the space between two words; but where margins are ample, the bottom pins should be placed in correct position. If they are fixed too near each other, there is a probability of the sheet becoming slightly tilted in the process of laying on; and if too far apart, the feeder is apt to let the sheet slip down between the pins and on to the rollers. A little experience is sufficient to enable the feeder to locate the pins in the best manner. The side pin should be placed a little above the centre of the sheet; and for all work requiring accurate register, it is absolutely necessary that the side pin should be placed in the same position for each working.

Small work and cards are often fed from the taking-off board directly in front of the feeder, in preference to the feeding board. In this case, the pile of sheets is “stroked out” towards the feeder, and each sheet or card is taken in hand with the thumb on the under side, with three fingers spread on the upper side of the sheet, the little finger being placed against the edge of the sheet for the purpose of pushing it up to the side pin. In every case the sheet or card should strike the two bottom pins first, and then slide along steadily until the side pin is reached.

This method, whilst satisfactory for small work, cannot be recommended as the best for anything larger than foolscap 8vo. Sizes beyond that should be placed on the feed board to the right of the feeder, and the pile of sheets should be stroked out towards the right-hand corner nearest to him. If, however, the machine requires a left-hand feed, the method

is simply reversed. Each sheet should be taken hold of at the corner, with the thumb on the upper side and the fingers underneath. Slightly raise the sheet and spread the fingers a little, causing the other two nearest corners to lift slightly. The sheet will then have something of the appearance of a scoop. A certain strength or backbone is thus imparted to the paper, which enables the feeder to handle a demy folio sheet with the greatest ease. As in the case of small sizes, the sheet should strike the two bottom pins first, and then be pushed along to the side pin.

Difficulties in Working. Slurring is one of the most annoying incidents of platen work, and arises from so many causes as to often become a puzzling matter for the inexperienced. It is usually due to one of the following causes:—

- False motion of the platen ;
- Insecure locking of the chase in the type bed ;
- A springy forme ;
- A baggy tympan ;
- Improperly adjusted frisket fingers ;
- Weakness in the machine.

To ascertain whether the false motion of the platen is the cause, examine the impression studs, and make sure that none of them are loose. It often happens that one stud is drawn back, and is loose, leaving the force of the impression to fall on the three remaining ones. This would very likely cause the platen to spring, and result in a slur. The remedy is to readjust the platen, so that it will meet the type with a perfectly parallel and even pressure.

Insecure locking of the chase on the bed may be overcome by placing card of the required thickness between the chase and roller bearer, and also between the chase-clip and the chase, before pushing the forme home in the type bed.

A springy forme should be taken off from the machine, unlocked and planed down ; then carefully re-locked. If the fault is with the chase, put a strip of cardboard, a pica wide, between the top of the furniture and the chase all round. This will overcome the tendency to spring.

In most cases a baggy tympan is the source of the whole trouble. If so, draw it tight. See if it is not loose at one point and tight at another. When there are several

sheets of cardboard, etc., under the top sheet, the imprisoned air may cause a slur. This can be overcome by using one thick cardboard in place of the several sheets. If warped and uneven, reject it and use a flat sheet. See that the cardboard is not too large; should this be the case the tightly-drawn tympan will warp it.

As a preventive against slurring through baggy tympan as much of the make-ready as is practicable should be done at the back of the forme.

In open formes where the sheet is inclined to drop in the spaces a thin board should be substituted for the top sheets which usually form the tympan; or, where possible, fix a frisket finger by the side of the slur. To give it a firmer grip glue a piece of cork, the thickness of a great primer, upon it at the point where the slur is most prominent.

Notice how the frisket fingers strike the platen. They must come down perfectly flat at all points alike, and not slide upward after they have once touched the platen; neither must they loosen their pressure upon the sheet until they leave it entirely. A sliding finger may move the sheet so as to crowd it against one of the gauges. The sheet will then be baggy when it reaches the forme, and a slur is inevitable. One finger may be tested first, then the other.

If the forme will allow it a rubber band or two—one above and one below the forme—may be stretched from finger to finger. If a two or four-page forme, rubber bands or tapes may be used between the pages, forming a kind of frisket.

If any creasing shows itself a strip of glazed board may be fastened across the top of the gripper fingers, so as to keep the sheet perfectly flat as it approaches the impression. Pieces of cork fixed to the forme, so as to press on to the fingers, will prevent slur while the sheet is leaving the forme.

The following advice, coming from so expert a printer as Mr. W. J. Kelly, of New York, is worthy of careful attention. He says, in his "*Manual of Presswork*," "It will be conceded that hard packing, and very little of that, is the best that can be adopted for general job printing on platen machines. For all small formes I use a sheet of thin cardboard next to the platen, and draw over this from two to three thicknesses of

smooth hard paper, the top one acting as a cover to the make-ready. If a card is to be printed I leave out the cardboard and merely use the few sheets of paper. Where practicable, it is wise to keep presses set to this degree of impression, as larger formes can be adjusted for printing by the addition of a few more tympan sheets.

“In working off large formes containing solid type matter, handbills, etc., I have found that the make-ready is quicker, and that the press runs easier, when one or two thicknesses of thin calico are placed next to the face of the platen. This can be varied by using a sheet of ordinary blotting paper in lieu of the calico. This will also be found a desirable tympan for printing on folded envelopes, rough and common quality papers, etc., in which case the calico or blotting paper should be moved up nearer to the face of the printing surface.

“When executing registered work on platen presses the top sheet should be of strong smooth paper, and firmly fastened with paste or other means on the off and near ends of the platen, so that the fingers in the action cannot loosen it from under the tympan fasteners on those ends. In no case allow the make-up of the tympan to so extend as to be under the bearers on the type bed of the machine when working.

“To prevent slurring, all formes should be locked up below the centre of the chase where possible. This method of lock-up will materially assist the action of the draw-arms of the press when passing over the point of impression, and also steady the entire mechanism of the machine at its point of greatest resistance.”

CHAPTER IV.

THE WHARFEDALE MACHINE.

MECHANICAL FEATURES.

CYLINDER machines differ essentially from the hand press and the platen machine. In the last two the paper is impressed against the forme by a flat plate of iron—the platen. The forme and the platen may be in a horizontal position, as in the press, or in a vertical position, as in the platen machine ; but the principle is the same. In Fig. 20, the shaded portion represents the bed of a platen machine, the black portion the forme, and the open portion the platen.

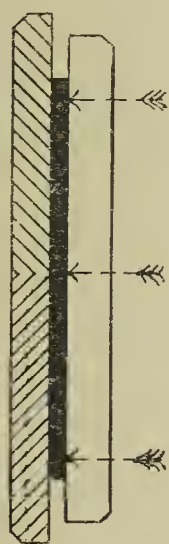


FIG. 20.

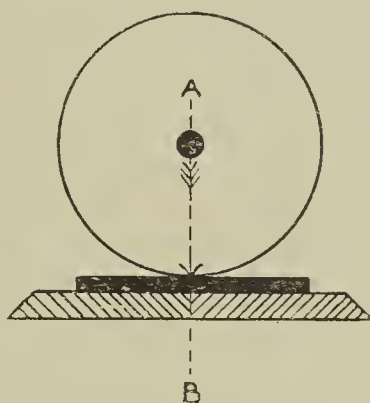


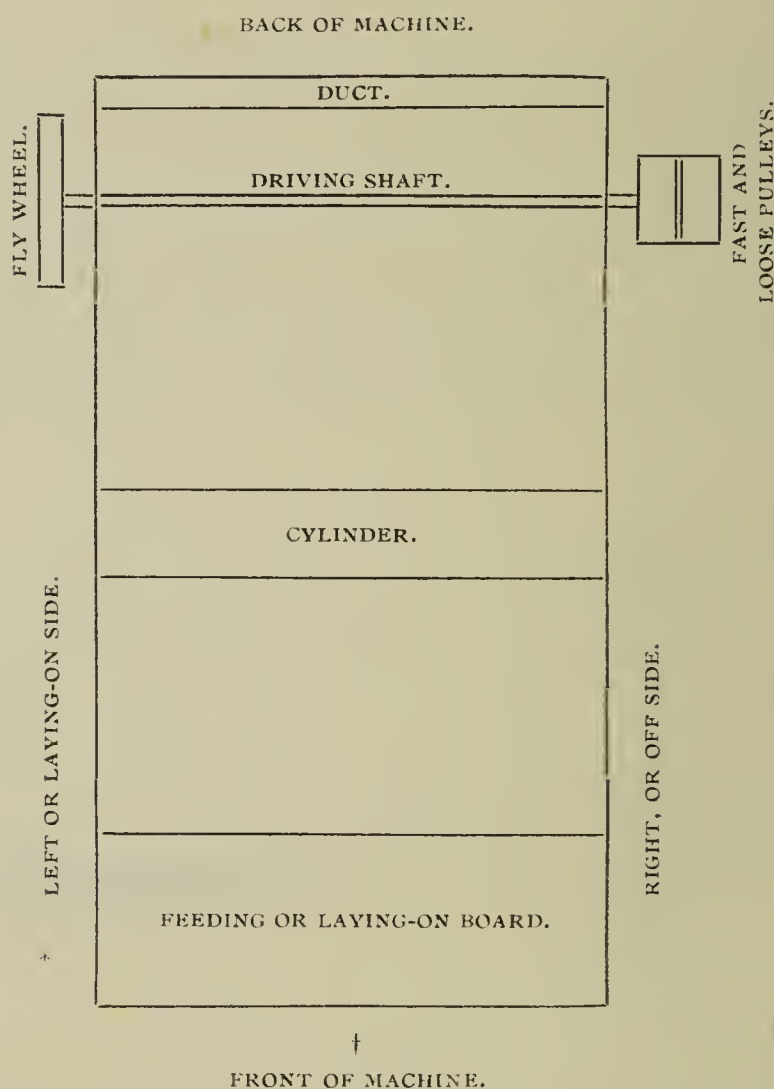
FIG. 21.

The cylinder principle is shown in Fig. 21. The shaded parts indicate the bed and forme. The circle represents a cylinder of iron, which presses downward upon the forme. The pressure is exerted at the point in which the line *a b* intersects the cylinder and forme.

The result of this arrangement is, that while in the press the whole of the forme is impressed at once by the platen, in the cylinder machine only an extremely narrow portion of it

—depending upon the circumference of the cylinder—is impressed at once. Accordingly, either the cylinder must revolve, and pass over a stationary forme; or, the cylinder being fixed in its bearings, and revolving, the forme must move underneath it, in order that the whole of the forme may be impressed.

In some of the early cylinder machines, the cylinder was caused to pass over the forme from end to end, and the forme



* Position of layer-on, except he is pointing, when he stands at †

remained stationary. In all classes of Wharfedale machines now made, the cylinder, supported upon a shaft, revolves upon brasses, fixed into brackets, fitted to each side of the machine. The type travels to and fro beneath the cylinder.

The backward and forward, or to and fro motion of the bed is called the reciprocating motion, or the travel of the machine.

Another distinction between the two classes of appliances consists in the different manner of inking. When the platen principle is adopted, the inking rollers travel over the forme. In cylinder machines, the forme travels under the rollers, which are fixed in their bearings, while rotating.

The following description applies to the class of cylinder machines known as the Wharfedale, being so called because they were first manufactured in the Wharfedale district of Yorkshire. A number of engineers now produce the Wharfedale machine, and all are designed on the same general principles. The machines of some makers possess various improvements in details, but these need not receive description here.

The diagram on preceding page is a rough skeleton plan of the machine, showing the relative positions of the essential parts, and giving the names of the sides, as back, front, left and right sides. These terms are not always correctly used by printers.

A carriage or bed carries the forme of type, and also the ink table, which is adjacent. This carriage has a reciprocating motion or travel, to and fro. It is caused to travel by the driving shaft, extending right across the machine, near the back, as shown in the diagram. In the middle of the driving shaft are two spur wheels, and these are geared into the two main driving wheels. The double wheels ensure that steadiness of driving which is most important in a printing machine. The main driving wheels are fastened to two short shafts, upon which are also fitted various cams and eccentrics, these wheels being coupled by a connecting pin which can be moved backward or forward, to lengthen or shorten the stroke of the crank. The driving wheels, being coupled at their extreme edge, cause the crank shaft, which is hung upon the connecting pin, to give the necessary "throw" to two wheels at the other end of the crank. These are called the rack or traverse wheels, and they travel backwards and forwards over two bottom racks, being impelled by the connecting shaft. Above them, but below the carriage, are two corresponding racks which gear into the traverse wheels, and move with them. The upper racks are immovable. The wheels and the upper rack cause the motion of the carriage

backward and forward; while the cylinder, by means of another rack screwed upon the surface of the carriage, is made to revolve, and the inking arrangements are set in motion.

The carriage runs on anti-friction rollers or bowls, running on two or four rails, according to the size of the machine. These rails are made to receive friction rollers, or what are called runners, because it is on them that the carriage runs. The rails are strengthened underneath the cylinder by the "stretcher," a very strong girder, extending from the left to the right side frames, the rails resting upon and being fastened to the cross frames.

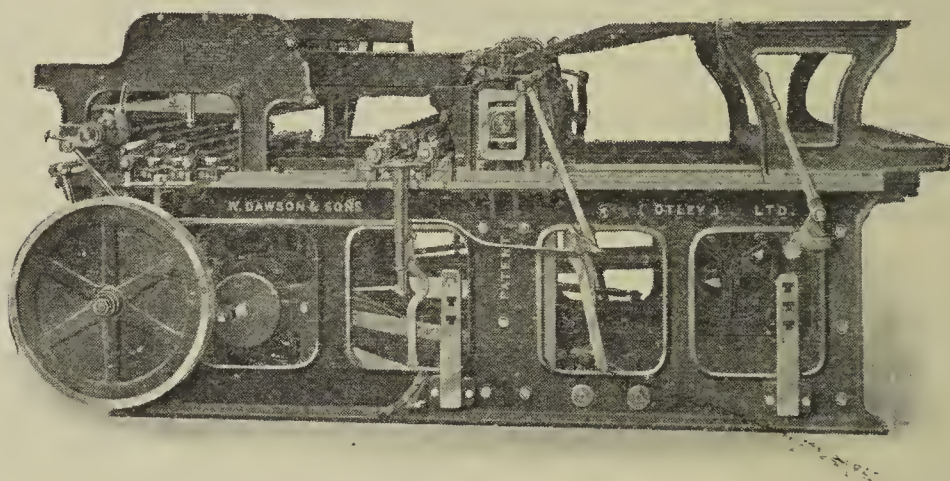


FIG. 22. DAWSON'S SUMMIT WHARFEDALE MACHINE.

Movement of the Cylinder. The top of the carriage has a toothed rack at each side, and these drive spur wheels on the end of the cylinder. One of these spur wheels is securely fastened to the cylinder, while the other continues revolving when the cylinder is stopped. The cylinder is a metal drum, with a portion cut out the whole length. It turns from right to left when looked at from the feed side. While the table runs towards the laying-on board the cylinder stands still. This is effected by the two wheels at the ends of the cylinder. That at the off side is a fixed spur wheel, having a "flat" upon the under portion. That is, some of the teeth are cut off to allow the carriage to return. Otherwise the cylinder would turn the reverse way. The wheel on the opposite or laying-on side is a loose wheel, and it starts the cylinder when it becomes locked by the cylinder catch.

The part of the cylinder between the bearers is the printing surface. It is turned so as to be a 4-to pica less than the ends, to allow for the packing. This is called the "beard" of the cylinder.

Close to the hand of the layer-on is a handle which, when turned, throws on or off the belt, and thus starts or stops the machine. The fast and loose pulleys are, as shown in the diagram, on the off side, and this handle is directly connected with them. It is also connected to a brake beneath the fly-wheel, which assists in bringing the machine to a standstill when required.

The Feed or Laying-on Board is, in the Wharfedale machine, at the base of the cylinder, not at the "crown," as in machines to be mentioned hereafter. The board is in two parts. The front part, which slopes like a desk, slightly rises when a sheet is to be taken in; the back, which is horizontal, is stationary, but fitted so that it can be taken off when required.

On the front of the board are the gauges, or "lays," to which the sheet of paper is laid. They permit of register being secured without the use of "pointing" apparatus, which however is provided for unusually accurate work.

Behind the board are the *grippers*, which are movable along the gripper bar. Before the cylinder is ready to start, the grippers close and take the sheet, which they hold while the cylinder revolves. At a certain point they open and release the sheet. It can be removed by the taker-off, or by the mechanism called the flyers. When machines were first introduced, the printed sheets were taken off by an attendant, who rapidly plucked them out of the open grippers, and deftly laid them in a neat pile, the resistance of the air keeping them in a horizontal position immediately before being deposited on the heap. This was called "flying" the sheet. The automatic mechanism for the same end is known as the "flyers."

The Flyers. This apparatus consists of four parts—the flying drum, the rubber rollers, the tapes, and the gate. The drum is of wood, and is half the circumference of the printing cylinder; hence it makes two revolutions to one of the cylinder. The drum is provided with grippers, which alternate with those of the cylinder. The rubber-coated rollers

are adjusted on a spindle, so that they will come in contact only with the unprinted margins of the paper. The gate is a sort of oblong hand, with wooden laths instead of fingers. The action is as follows:—When the sheet is printed the grippers of the cylinder open, and the grippers of the flying drum seize the sheet and carry it around the drum. The sheet is held beneath the rubber rings, and as the flying drum revolves, they force the sheet down the tapes on to the gate, to which it temporarily adheres. The gate descends on the taking-off board, and deposits the sheet printed side upwards. One after another the sheets are thus disposed of, and form a regular pile. The chief advantage of the attachment is that it saves labour, in dispensing with the work of the taker-off, and that it obviates the danger of the sheet being smudged by his fingers.

The flying apparatus should be designed so as to be lifted bodily, by simply depressing a lever requiring but a minimum of effort, and move instantly clear of the impression cylinder, thereby giving free and easy access to the cylinder for the purposes of making ready, or of taking off by hand. The apparatus should be free from outside or overhead tackle.

The Inking Arrangements. The principal parts are: the duct, the duct cylinder, the feeder, the distributing and inking rollers. The duct, which in this type of machine is at the back, is a metal trough for holding the ink. One side of this is formed by a cast-iron roller called the ink duct cylinder, which revolves. The other side is formed by a triangular piece of iron called the duct knife. The closeness of the cylinder to the duct regulates the quantity of ink given out. This proximity is regulated by screws in the back of the duct and may be adjusted with nicety. At one end, on the off side of the duct cylinder is a small wheel, by which it may be turned by hand. On the other end, the left side, is a pawl and ratchet, which turns it as required, the pawl and ratchet being worked by the duct rod, connected with mechanism on the inside of the frame, whereby the ink delivery is quite automatic. Once arranged, the supply is absolutely uniform, however long the run of the job may be.

Next to the duct cylinder is a composition roller called the

feeder, moving up and down, transferring the ink from the duct to the ink table. Next come the distributors, or wavers, of which there may be four. They are placed transversely across the machine, that is at an angle, and distribute the ink put upon the table by the feeder. They are not geared, but receive their motion from that of the ink table. The inking and distributing roller stocks are made of steel tubing and covered with roller composition.

The actual inking of the forme is done by the inkers, which receive their motion from the carriage. There are usually four of them, each in its own "fork." In the best machines there are arrangements for keeping the rollers in their places, and preventing jumping.

In the better kinds of machines the coating of ink on the inkers is further equalised by "riders," which are rollers made of steel tubing. They move to and fro, endways.

Pointing. The following is the best method for ensuring perfect register, however rough the edges of the paper may be when fed into the gauges for the first side printing:—When pointing is to be done, a pair of points is fixed, one at each end of the centre cross of the chase upon the bed. Care should be taken to see that these points pierce the sheets as the work is being printed. When the work is ready for backing, the points, attached to a framework beneath the lay-on board are raised above the brass gratings. These are adjusted and made to fit the holes in the printed sheet. The pointer lays the second side on to these points, which work automatically, dropping clear of the sheet as the lay-on board rises and the grippers take the sheet. The gauges are drawn to both sides of the feed board to allow the pointer more freedom. On some machines where the gauges are fixtures, an arrangement is used by which the latter are lowered below the level of the lay-on board.

The Foundation. A firm foundation is most important if a machine is intended to do good work and undue wear and tear averted. The flooring may be cut away and a concrete bed made, at least a foot in thickness, extending both ways a little beyond the space actually occupied by the machine. There should be an intervening block of wood for the feet of the machine to rest upon. This will deaden the sound usually

heard when the machine is laid direct on concrete or brick floors.

The Framework. This consists of two side frames, three cross stays, and two pairs of longitudinal stays, with two bowl or runner rails. The frame is bolted and pinned together. Pinning consists of projecting studs of steel in the frame, with corresponding holes in the stays. This facilitates re-erection of a machine, as no further "setting" of the frame beyond that done by the makers is necessary.

Machines of double royal size and upwards are usually fitted with four cross stays, the extra one being placed beneath the part which receives the impression. There should also be four bowl rails, as this number will ensure greater steadiness of the bed whilst it is running, and it will run more smoothly. Machines for use in jobbing offices should always be very solidly built, owing to the variety of work done upon them.

The Cylinder Bearings. These should be type high. On no account must they be above type high, for if otherwise they involve more packing on the cylinder than the beard will allow of, thus causing slurring and thickening of the print at the edges of formes. Some machinemen, when this occurs, tack pieces of leather or cardboard on the bearers in a line with the slur. This is objectionable, for when removed they leave an indentation behind, which will eventually ease off the pressure, and prevent the cylinder running smoothly on the bearers.

The sheets to be printed are laid upon the flat part of the feed table. They are taken singly to the sloping part, and laid by the feeder close up to the lays or guides which are at the gripper side and the side facing the layer on. This part of the table is hinged at one end, while the other is raised by a cam and lever arrangement. The lever lifts the board, thus enabling the sheet to reach the end of the cylinder. The grippers now close on the sheet, the cylinder revolves, and the impression is obtained.

In the machine room there are two classes of artisans: (1) the machine minders, who put the forme on the machine, make ready, and superintend the working off; (2) the layers on, or printer's labourers, who merely feed in the sheets. The latter work is frequently done by boys and girls.

The essential requisites in a machine intended to produce the best kind of work—especially that in which exact register is required, such as colour work—are these :—

The cylinder and carriage must always come into contact in exactly the same relative position.

The cylinder must start and stop at exactly the same place each revolution.

The carriage must be made a good sliding fit in the frame.

The cylinder must fit its bearings so that there is no side play.

The teeth of the wheels and rack must be of correct size and shape.

The bearers must be of the proper height, and kept in contact with the cylinder belts when in motion.

Impression Bearers. The bearers should be tested from time to time, especially if new, in view of possible shrinkage. Any defect in this respect must be remedied by packing under the bearer, and not by lowering the cylinder. In some modern machines the bearers are not of wood, but of steel, planed dead true. The centre is of leather to give a firm hold of the cylinder, and to prevent slipping.

The Cylinder Brasses. When screwed together the bearings should just clip the shaft. When worn, they can be brought together by filing down the shoulders. If too tight, pack between them until the brasses can be screwed down without jamming the cylinder. It is advisable when altering worn brasses to file off enough to allow about a 12-to pica between them, so that any future wear can be taken up without much trouble. All that is then necessary will be to remove as much of the packing from between the shoulders of the brasses as is required. There should be lock nuts to impression screws on every machine, either large or small. It will then be impossible for the impression to work off. Moving them up and down to regulate the impression should be strictly avoided.

Treatment of Grippers. Care should be taken that all the grippers are set regularly. None of them should grip the extreme edges of the sheet. It is imperative that they hold the sheet tightly. Much bad register is caused by the grippers not holding the sheet quite firmly. In working jobs that require close register a strip of blotting paper may be placed

along the gripper edge of the machine, or a piece under each gripper. There are, however, some machines on which it is impossible to get perfect register.

In few machines is the action of board and grippers thoroughly accurate, and, indeed, this is the great fault of inferior machines. Usually the action of the feed board, grippers, and the locking of the cylinder takes place at the same moment. This should not be the case. The cylinder should be quite stationary before the board rises, and the grippers and feed board should have done their work before the cylinder locks. The grippers should always be below the sheet until it reaches the level of the cylinder. They should then close instantly, the cylinder locking directly afterwards.

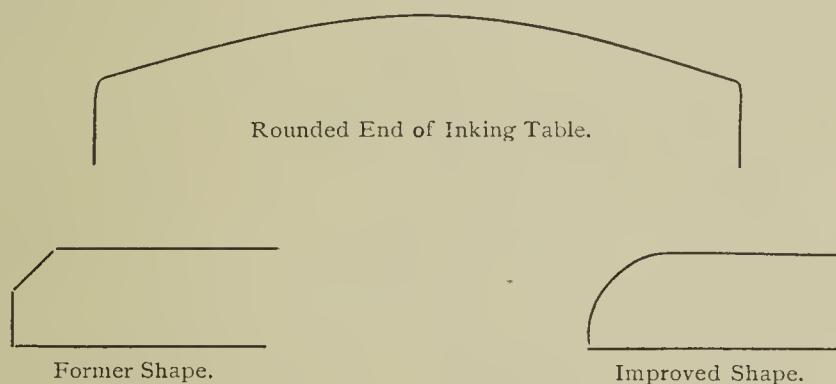
In machines of the best construction, when the cylinder is checked the board and grippers remain stationary until put in action again. The checking is also arranged on the automatic principle, so that it is impossible to throw the cylinder out of gear by throwing the check off at the last moment.

Prevention of "Sagging." Some tapes may be fastened to the rods upon the machine for that purpose, and run in the blanks of the forme, care being taken that they do not shift, and that they are moved when another forme is put on. Another method, and one that is equally effective, is to fasten strips of pliable card to the feed board, extending them about an inch beyond the brass plate. Place them so that one will come in the centre and one on each side of it, about equal distances apart. Cut the cards about an inch or an inch-and-a-half wide, and in length let them reach to the gauge grooves to prevent the sheets catching in them.

Geared Rollers. The advantage of these is so great that it is surprising to find printers ordering machines without them. The value of this addition to a machine can hardly be over-estimated. Not only is sharper and more solid printing obtained, but it will be found that with this appliance jobs will work more cleanly, as the distribution is so effectual, and a smaller quantity of ink is required to cover the forme. It must not, nevertheless, be concluded that such rollers will work all kinds of coloured inks cleanly, irrespective of the quality of the ink. There are some coloured inks which cannot possibly be made to work cleanly for any considerable

length of time. If rollers are fitted with gearing it is less necessary to double-roll a job. The rollers should be geared direct into a cog rack fixed to the bed, and the tube riders driven by friction. Each roller should carry a separate rider, or, if required, a larger one can be worked between two rollers. Both methods of distribution may thus be combined in connection with the one gearing. For a very heavy forme two large riders may be worked between the three front rollers and one of the smaller ones on each of the others; or four large riders can be worked between five inkers.

Fraying on Rollers. The distribution of the ink as it leaves the duct is effected by the wavers, which are rollers working at an oblique angle to each other. There is much trouble caused by the constant fraying or chipping of the ends of these rollers. The bits of composition broken off become distributed over the inking table, and are conveyed to the forme, causing "picks" or, as they used to be called, monks. To prevent this evil avoid a square-edged inking slab. In a double-demy machine the edge should be rounded, so that the centre projects about two-and-a-half inches beyond the ends, as



By adopting this shape the table strikes the rollers more on the level. Of course, the distributors must cease revolving before the table returns, as they are turning in an opposite direction, and the strain caused by the two meeting would be dangerous. To prevent this a stiff lubricant should be used for the spindles of the distributors. This precaution will to some extent meet the difficulty, but the front of the table has to be considered. On most machines lifters are fitted to raise the distributors clear of the forme when the machine is run

out its full length. One end of the distributors, being worked at an angle, drops on to the slab before the other, and this constant striking and running on one end seriously wears the roller. As a remedy, all distributors that do not reach the forme should have the lifters removed, and they will thus be allowed to remain level. The front one, however, has to be so adjusted that both ends will rise and fall simultaneously. The best way is to connect the lifters one with another. Another method is to have the inclines which actuate the lifters slotted in such a manner that they can be adjusted to the front distributor, by setting them so that the inclines reach both ends at the same time. On some machines it would not be possible to follow this plan, as the inclines are cast with the bed. Any new machine may be ordered with adjustable inclines. The ink regulation can be effected while the machine is in motion. It should be arranged so that it can be set to take no ink at all, or to any extent permitted by the number of teeth, and instantly. This will be found a great saving as compared with the old arrangement of a slot in the ductor cam, which required a spanner for its adjustment.

The Flyers, shown in the diagram, are an improvement on the old form, being lifted clear instantaneously, so that the machineman can work at the forme or cylinder without being in any way hampered. The flyers and drum are combined, thus leaving the delivery board clear. To alter the grip of flyers for thick or thin sheets, or for printed matter with narrow margin, the flyer cog-wheel on the impression cylinder is slotted so that it can be adjusted. In some machines there is no provision for this. The grip then must be regulated by opening or closing the grippers. They are opened for more, and closed somewhat for less grip.

Improvements in the Wharfedale Machine. In order to adapt this machine more perfectly for fine art printing, which requires an extremely heavy and solid impression, and much superior inking arrangements than those described above, makers have introduced considerable improvements, while retaining the general principles.

Amongst other makers Elliott & Co. (Otley), Ltd., make a special Wharfedale machine for high-class and illustrated work in which several new features are embodied. The construction

throughout is designed to withstand the heaviest impression. The framework is bound together by four cross rails, the two end cross rails and one of the centre rails being connected at the top in order to give extra resistance in withstanding the impression of the cylinder. The type table moves on four sets of bowls, which are adjustable, so as to minimise the wearing of the reversing positions. The gearing of the machine throughout is cut from the solid metal, which ensures the greatest harmony of action when the machine is in motion.

The *inking arrangement* is specially designed to obtain the finest distribution. The ink is taken by an intermediate carrier roller from the ordinary duct to a revolving steel drum. Here it is distributed, by two composition rollers, over the surface of the drum. The operation is assisted by the drum being provided with an arrangement reciprocating the surface endways during the process of revolution. From hence the ink is taken by another carrier roller and put upon the ink slab connected with the type table. The ink is then worked upon the slab surface by the distributor, assisted by a steel tube placed over the top of each. By the movement of the type table the ink is now taken to the surface of the forme inking rollers. There are four of these, and they clear a full-sized forme. Distribution is obtained by the ordinary geared inking method, assisted by two composition rollers above the two steel tubes, in conjunction with an additional steel tube revolving and reciprocating between the two composition rollers. The entire series form a complete connection between the first and last rollers in pyramidical form, and through the continual revolving and reciprocating motion a well-worked supply of ink is applied to the forme. The supply of ink from the duct can be instantly regulated while the machine is running. There is also fitted on the machine a motion for rolling the forme twice to one impression of the cylinder. The distributors can be lifted clear of the forme surface at any time, according to the angle of the first distributor. When the machine is not working the forme rollers can be instantly raised clear of the type, thus preventing any damage arising from the rollers being left to rest on their own surface.

The *feeding arrangement* is designed with the view of

ensuring perfect register. The feed board is made to slant so that when the sheet is fed, its edge always keeps to the front gauges. The side register of the sheet is determined by gauges having an automatic movement which brings the sheet, after being placed on the board, to the exact position of its predecessor. These side gauges are adjustable to different sized sheets. The front gauges rise with the board and keep the sheet in position until it is clasped by the grippers.

An arrangement is fitted on the feed board for carrying a set of steel fingers for smoothing the sheet to the cylinder surface, thus preventing creases being formed before the paper comes into contact with the type.

Improvements are also made in the *delivery arrangements*. The laths which deliver the printed sheet are fitted with small brass star-shaped wheels, to prevent the wood from coming into contact with the printed matter. The flyer laths and grippers are adjustable, so as to allow of the tapes being placed to clear any particular matter, or illustrations. The laths also are made to take a full-sized sheet, thus preventing any damage being done to the paper in flying it. The delivery apparatus is balanced, and can be immediately raised, giving ready and instant access to either the forme or the cylinder. It can also be lowered into working order in a similarly expeditious manner.

An arrangement for slitting the printed sheet is fitted on the machine when required. This motion is so designed that if it is necessary that the sheet should not be divided, the arrangement can be taken out of gear instantly.

The cylinder can be checked at any moment by moving either a hand or foot lever. This movement also stops the ink supply from the duct, the grippers from closing, the cylinder pusher-bar from falling (thus preventing the cylinder from getting a false start), the feed board from rising, and the front gauges from dropping. These are effected automatically, and simultaneously with the checking of the cylinder.

The cylinder bearers are made of iron, with wood inserted in the centre to preserve contact with the cylinder surface.

Another typical machine for high-class work is made by Elliott & Co. (Otley), Ltd., in which the preceding features

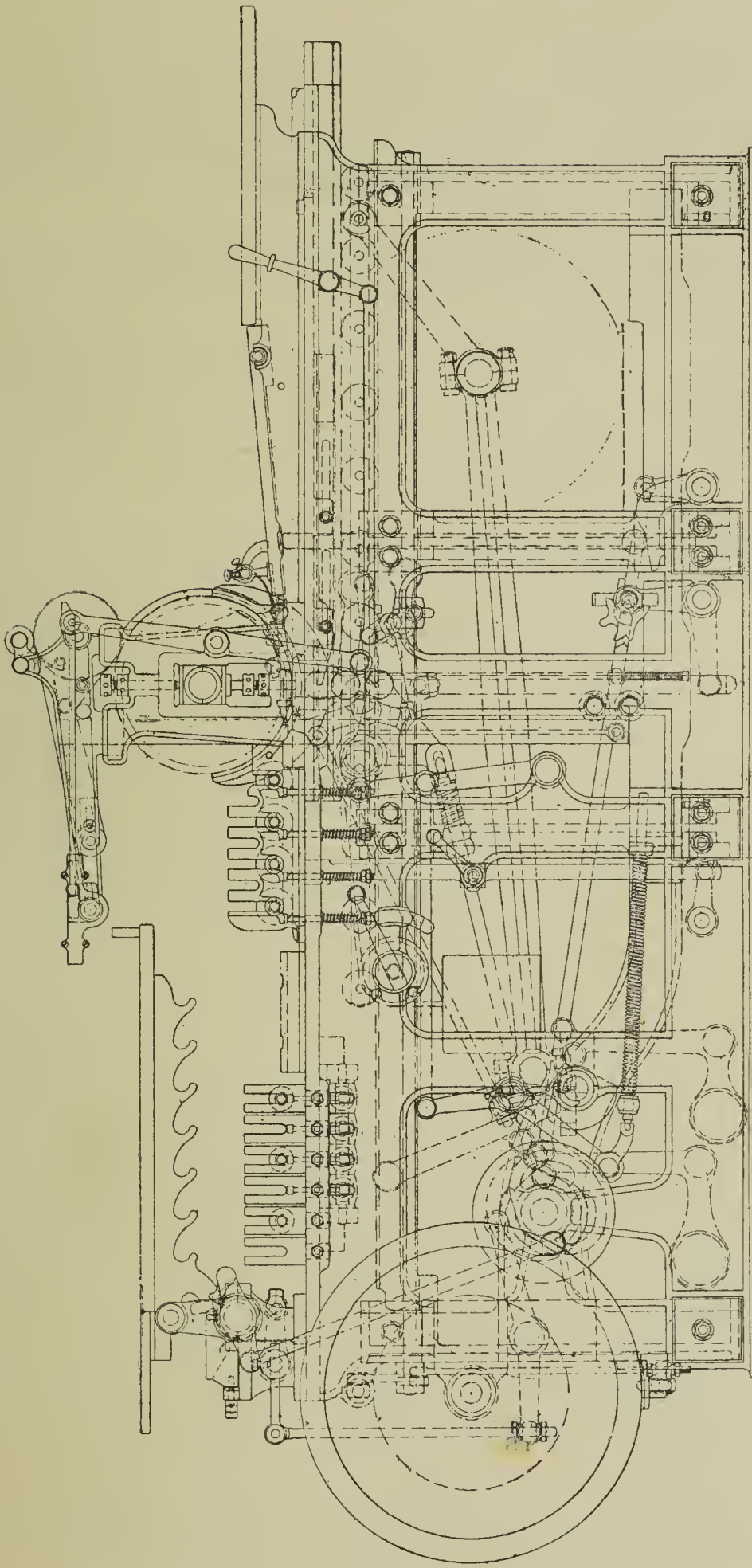


FIG. 23. WHARFEDALE MACHINE OF ELLIOTT & CO. (OTLEY), LTD.

are embodied with the exception of those comprised in the inking arrangements. In this machine the whole set of rollers, distributors, steel tubes, ductor, and ink duct are grouped in one pile. The ink is distributed and conveyed to the forme rollers by cylindrical movement direct, thus dispensing with the ink slab.

Various other modifications have been made by several engineers in this class of machines.

CHAPTER V.

MAKING READY ON WHARFEDALE MACHINES.

IN the present chapter will be given directions for making ready on a Wharfedale machine ordinary formes consisting of movable type, borders, and rules, and in a subsequent chapter directions for making ready woodcuts and process blocks.

The art of making ready includes a variety of processes, all of which must be carefully and efficiently carried out. Amongst them are :—

- Placing the forme in position.
- Verifying the margin.
- Making register.
- Working up colour.
- Setting the impression.
- Preparing the rollers.
- Selecting suitable ink to paper.
- Adjusting bearers.
- Underlaying.
- Preparing the tympan.
- Overlaying.

The forme should be lowered gently down upon the bed of the machine, not dropped from halfway—a bad system much in vogue in most machine rooms. The forme should then be planed down. If it shows signs of being springy the quoins should be slightly slackened, the type planed gently over, and then locked up again. An impression is then pulled, and the work of underlaying begun.

Underlaying. This is a matter of great importance, for to a great extent the successful working and appearance of a job depend on it.

Underlaying consists in patching up from the back such letters or lines as are very low in the forme, and which would

consequently neither be properly inked by the rollers nor receive the due amount of pressure from the cylinder.

Why Underlaying is necessary. If an impression is pulled on a sheet of paper, especially from a forme containing metal and wood type, or metal type and woodcuts, stereos, electros, etc., it will be found that the proof, both on the face and at the back, shows various degrees of inequality of pressure. These inequalities of pressure arise from varying thicknesses or heights in the printing surface. It is necessary to adjust these inequalities, whether they arise from the surface being too low or too high. If allowed to remain (1) the rollers would not cover the printing surface uniformly; (2) the paper would not be impressed evenly on the forme; (3) the plan of overlaying—to be subsequently referred to—would not suffice to bring up the lower parts sharply and clearly.

The machinist takes a sheet of thinner paper than the job will be worked on, and pulls an impression. Next, a “miss” is printed on the cylinder, and all the low places in the trial sheet are cut out and placed on the cylinder with thin paste in their exactly corresponding places. This operation is repeated until a perfectly even impression is obtained. When all the patching is done the requisite number of sheets should be placed on the cylinder. They need not be pasted down. This will facilitate access to the make-ready, if necessary, afterwards. Lastly, the whole is covered over with a stout sheet.

During the process of underlaying, the forme may be held securely in position by means of a wrought-iron bar resting on the bed of the machine and supporting the forme at an angle of about 75 degrees. The forme may be secured to the bar by the aid of a thumb-screw at the top. This is better than trusting to a layer-on to hold the forme.

The Tympan. The word tympan is applied to the covering of the cylinder, which corresponds to the paper inside the tympan of the hand press. The expression is not etymologically correct, as it actually means something stretched like the head of a drum, but it has been adopted for presswork and being in general use must be followed. The covering is also called the “packing.” Whilst, however, some machinists speak of packing the cylinder, others speak of dressing it.

There are various kinds of tympanans :

Soft, for posters ;

Medium, for jobbing ;

Hard, for fine book-work.

For preparing and fixing these various plans are adopted. Cylinders vary considerably in depth of beard. Some take as many as fourteen sheets ; others only half a dozen. In a machine that is used principally for fine cut work, the beard should allow for eight sheets of stout double demy. If a machine is being ordered, a 4-to pica brass rule may be sent as a gauge.

Much trouble would be avoided in working cylinder machines if pressmen would make it their business to know exactly how much packing their machines need. Too much packing increases the surface of the cylinder to a dangerous extent, and as the cylinder is usually planed dead true, something is bound to give when the packing is too thick. When the cylinder has been overpacked, it travels slightly quicker than the carriage, which causes the sheets to drag, and upsets all make-ready upon the top.

In preparation for fine book-work, some machinemen first grease the cylinder to prevent rust. Either fine long-cloth calico or cambric is put on next to the cylinder as a foundation on which to paste the sheets. Then a damp sheet, which will reach from the front to the back edge of the cylinder, so as to keep the calico clean when short sheets are fastened to it, is drawn over. This stands a few minutes to dry. Then three dry sheets, pasted along the front edge only, and secured at the back with a gum slip, are put on. Damp a sheet to extend beyond the dry sheets, and draw tightly over all, leaving two sheets for the process of making ready.

For quick jobbing, in an office where there is much commercial work, such as ledger headings, memo. forms, letter headings, invoice forms, etc., the following cylinder packing will be found most suitable :—If the cylinder carries twelve sheets, insert eight below the calico. Four will remain for make-ready purposes. One of these will be pasted to the calico at the front edge, and a “miss” made. Touching this up according to the reference sheet, there will be three left to complete the necessary amount of impression. When the

sheets inside become worn at the front edges, they can be taken out and reversed.

In dressing the cylinder the whole of the packing should not be put on to commence with, in order that when the first impression is pulled a few sheets of paper can be placed on the top of the trial sheet to give the necessary pressure.

In printing a poster a blanket would be the packing used. If the forme contains a number of lines in small type, the heavy lines should be underlaid with strips of wrapper, thus raising them a trifle higher than the small lines. This plan will answer the double purpose—as a thin ink is necessary for this class of work—of preventing the rollers sinking in, and filling up the face of the small type; whilst the heavy letter, presenting a higher surface to the cylinder, will bear off the soft impression to the small lines from the blanket.

For book-work which is worked from stereo plates, a medium packing is best. If the cylinder carries ten sheets of 40-lb. double demy, paste two to the front edge of the cylinder, and insert five between these and the cambric, fastening the cambric over the whole, thus leaving three for the purpose of underlaying and patching up, the make-ready being put below the calico. Before fastening all up, the impression can be added to or reduced by putting in or removing some of the loose sheets.

Hard packing make-ready for fine illustrated work should be made similar to the above, but when finishing up a few harder sheets should be substituted for the softer ones below the calico. The two sheets for the final touching up upon the top of the cambric should be thin, but hard. If the making ready is below, a thicker overlay can be used, and better results will be obtained from the blocks. Some pressmen contend that however fine the cambric, the grain will present itself upon the block after a long run. This happens sometimes when the machineman has overpacked his cylinder, and the packing has been too hard beneath the cambric. This is due to carelessness on the part of the machineman, for a ply of tissue paper should decide whether the block will print well or appear “rotten.”

Damping the Tympan Sheets. As it is sometimes found beneficial to draw a damped sheet over the cylinder, to

Overlay - paper
super. calendered 28 lb. Demy

prevent slurring, it is handy to have a damping board in the office, which may be made after the following manner:— Obtain two good stout boards, painted or tarred on both sides, with two soft ream wrappers tacked on the face of each, and covered over with a piece of flannel, the latter being thoroughly soaked with water. Put the heavier board at the top, and let them stand for a day, when they will be ready for use. To keep them in good condition, damp over with a sponge occasionally, or sprinkle lightly with water at night before leaving the office.

When it is required to damp a sheet, fold it up the centre and place in the press. It will be ready by the time the dry sheets are pasted on. Then open out the sheet and paste on the inside, so that when fastened on the cylinder the dampest side is uppermost. A tympan so prepared is ready for use in less than five minutes. Do not let the sheet stay too long in the damping press, as too much damp would cause the dry sheets underneath to cockle. If the press is in good condition, two minutes is quite long enough for them to remain, and with a little practice it can be judged to a nicety. Always remember that thin sheets strain on better than thick. In stripping the cylinder, when changing formes, do not disturb the sheet on the calico. Its use is simply to keep the calico clean. Use ordinary printing sheets for damping; soft-sized sheets are unsuitable.

The disadvantage of the ordinary way of damping sheets is that either all the sheets must be damped or the dry sheets beneath cockle—the face of the tympan drying in wrinkles, or unsightly ridges. To this must be added the waste of time before the tympan is thoroughly dry. It may be noticed when dry sheets have been used beneath the calico that these sheets have creased, causing hard seams or ridges in the face of the calico. This results from the damp sheets.

The great drawback to the use of damp sheets is that it is not always convenient to keep the machine standing until the tympan is thoroughly dry. It is useless to begin making ready on a tympan that is not dry through, because as it dries it contracts and hardens. In the best offices all the paper used for packing is dry.

The Calico should be as fine grained as possible. Coarse

grained linen, American cloth, and thin rubber blankets, however, are sometimes to be found in use. These are very liable to impart their grain to the impression. If machine-men will use these coarse grained coverings, it is useless for makers of machines to spend so much time in making a cylinder perfectly smooth by taking out the engineering tool-marks.

Some pressmen prefer to work a calico over the overlays, but the calico must be of a very fine texture. This method allows of a thicker overlay, which can be buried well down below the sheets, and good results obtained. With such a method there is less liability to overpack, and carefulness will prevent any appearance of the grain of the calico appearing upon the block.

Patching up is the placing of patches upon the cylinder, partly to obtain an equal impression all over the sheet, and partly to give an extra impression on heavy letters or dark portions of blocks.

Rule Borders. The formes that require the hardest and tightest tympan are those which contain rule borders. Take, for example, an eight-page forme of rule borders, the text for the pages having to be printed afterwards. In order to lessen the likelihood of mackling or slurring, prepare the tympan as follows:—Place in position the calico and paper sheet as usual, then a sheet of manilla pasted along the front edge, and fastened at the back with gum slip. Try the pressure by running through a sheet with two 40-lb. sheets on top of it. If the pressure is not heavy enough, add sheets under the manilla; if it will carry two manillas or one shalloon board, use them instead of a number of sheets. When satisfactory pressure has been obtained, damp one of the two 40-lb. sheets, and strain over manilla, reserving the other, which should be damped, for covering all in. Underlay wherever possible, as the less patching there is on the cylinder the less risk is there of wrinkling. Work with as light an impression as possible to ensure solidity.

The following instructions are intended to meet some of the difficulties encountered in working single-cylinder machines.

Imperfect Register. One of the most common defects of a cylinder machine is the difficulty presented in obtaining

accurate register from it. A variety of causes may contribute to this, among which may be mentioned :

- The cylinder not riding firmly on the wooden bearers ;
- The slipping of the cylinder owing to the split brass bearings having become worn ;
- Unnecessary play between the short catch and the cylinder when the latter is pushed home by the adjusting rod ;
- Too much play between the traverse and the bed racks ;
- Wear of the friction bowls connected with the feed board, the push-back action, or the grippers ;
- The grippers not holding the sheet firmly and evenly ;
- The action of the feed board and the grippers not being in proper accord.

Insufficient rolling power. This is generally caused by the traverse of the carriage being too short. As a rule, in a certain class of machines, two rollers only clear a full-size forme each run. This would be remedied if the machine were made with longer traverse.

The absence of riders is a common cause of inadequate rolling.

Insufficient distributing power is a defect in the majority of machines. If the ink table were made longer, and there were more distributors, especially if riders were placed on each, this drawback would be overcome.

Friars are caused by defective rolling. The rollers may have shrunk, or the wooden bearers may have become worn, causing the rollers to skid or jump the type. The rollers should be properly adjusted to the type, and the bearers brought up to support their weight and prevent their dipping into the heads and feet of the forme. Geared rollers are very effective preventives of friars.

Springing of Formes. This arises from various causes, as

- Unequal justification ; the remedy is to have the matter put through the stick again ;
- A wrong fount space ;
- Leads too long for the matter ;
- Unequal locking up or too tight locking up ;
- Old and worn-out furniture and quoins which have warped, or battered furniture and leads.

Formes which contain blocks are often troublesome on account of their tendency to spring. The only remedy is to have the blocks squared and made true. Sometimes blocks are smaller at the bottom than the top, or *vice versa*; in this case springing may often be remedied by pasting on to the thinnest part of the block a narrow strip of card.

Draws. To prevent a draw, that is, the lifting up of parts of the forme by the rollers, it is necessary to see, in the first place, that the lines are perfectly justified. The chase must be perfectly square, and dressed with good furniture. In locking up the pressure should be exerted equally all round. When locked up, if the forme will lift, place a quoin under one side of the chase and gently tap the face of the type with the fingers. Any line which will give to the pressure should be marked, the forme unlocked, and the line justified. This should be done until every line is perfectly tight.

Slurring, due to the sheet being disturbed when in contact with the type, which results in a bleared or double impression, is a very common and troublesome difficulty. It is not possible to tabulate all the causes from which it may arise, and various remedies must be left to the intelligence of the machine minder.

To ascertain the cause of a slur, see

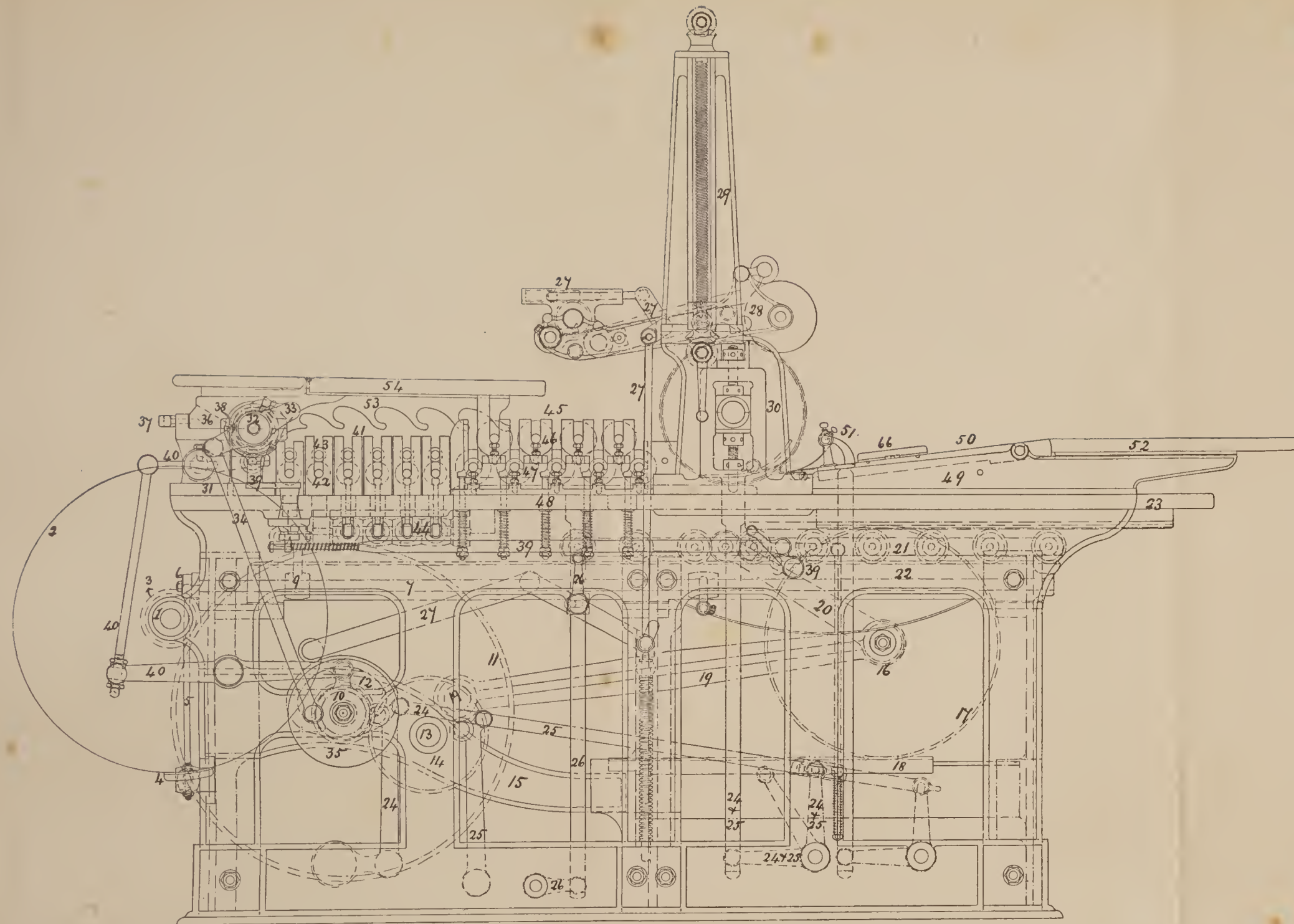
If the cylinder is properly down to the bearers. If the cylinder does not ride suitably on its wooden impression bearers they must be packed. The cylinder must not, however, be set down too hard on the bearers or it will get strained. The bearers should be set to type height.

If the packing of the cylinder is in any way loose.

If the brass or gun-metal bearing cups in which the cylinder shaft revolves have become worn.

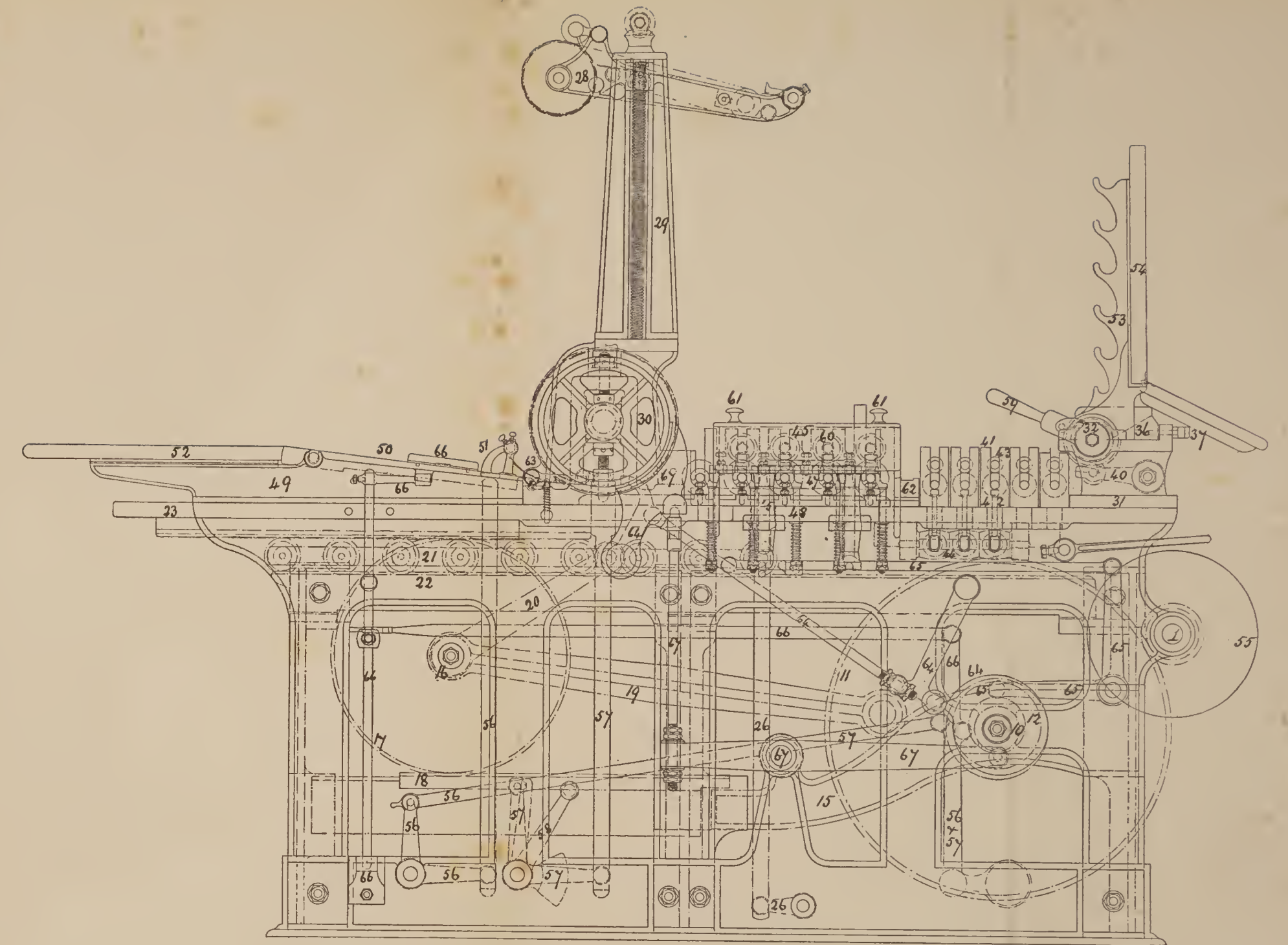
Worn brasses can be brought together by filing down the shoulders. If the brasses are too tight they should have packing between them—sufficient only to allow the impression screws to be screwed down without jamming the cylinder.

If the machine is all right in these respects, the slur may arise from there being too much packing on the cylinder. This will result in the circumference of the printing surface of the cylinder being out of harmony with the travel of the bed. The packing or blanket of any kind must not be higher



ELEVATION OF LEFT-HAND OR FEED SIDE OF THE MACHINE, SHOWING ALL PARTS THROUGH INTO CENTRE.

- | | |
|--|---|
| <p>1. Bearings of Shaft carrying flywheel, pinion, and fast and loose pulleys.
 2. Flywheel. 3. Pinions.
 4, 5, 6, 7, 8, and 9. Flywheel, Brake, and Belt Guide.
 10. Bearings of Shafts carrying driving wheels, double inking pinion, and cams for actuating various movements on machine.
 11. Driving Wheels. 12. Double Inking Pinion.
 13. Bearings of Shaft for double inking arrangements.
 14. Double Inking Wheel.
 15. Longitudinal Stays, also carrying bearings 10, 13, and 67.
 16. Shaft for Rack Wheels, connecting rod and bowl stays.
 17. Rack Wheels.
 18. Longitudinal Stays, also Racks for 17 to work in.
 19. Connecting Rod and Eccentric Bush.</p> | <p>20. Bowl Stays. 21. Bowls under Carriage.
 22. Longitudinal Stays, also Bowl Races. 23. Type Table.
 24. Appliance for automatic cylinder board, gripper, and ink check.
 25. Appliance for double inking.
 26. Appliance for lifting inking rollers clear of the forme on both sides of machine, also checking rider vibrations at same time.
 27. Appliance for working flyer laths.
 28. Sheet delivery combined.
 29. Slides for raising delivery apparatus clear of impression cylinder when making ready.
 30. Cylinder Bracket. 31. Ink Bracket. 32. Ink Roller.
 33. Catch or Feed attached to ink roller.
 34. Connecting Rod from cam to feed.
 35. Ductor Cam. 36. Ink Knife.</p> |
|--|---|



ELEVATION OF RIGHT-HAND SIDE OF THE MACHINE, SHOWING ALL PARTS THROUGH INTO CENTRE.

- | | |
|---|--|
| <p>37. Ink Regulating Screw.
 38. End Plates of Ink Knife.
 39. Appliance for checking ink supply at same time as cylinder is checked.
 40. Appliance for working ductor feed.
 41. Brackets for distributors. 42. Distributors.
 43. Tube Riders over distributors.
 44. Lifters for lifting distributors clear of forme.
 45. Bracket for inkers.
 46. Inkers used as riders. 47. Inkers.
 48. Spindles and Springs for holding inkers firm.
 49. Feed Board Bracket. 50. Feed Board.
 51. Smoothers and Side Gauges.
 52. Front Board. 53. Delivery Board Bracket.</p> | <p>54. Delivery Board. 55. Pulleys.
 56. Appliance for lifting feed board to meet cylinder grippers.
 57. Appliance for working grippers.
 58. Appliance for checking board.
 59. Handle, with catch attached, for turning ink roller in place of wheel.
 60. Tube Riders over inking rollers.
 61. Cover over bobbins of tube rider ends.
 62. Forme Slide.
 63. Short Stop to which cylinder is pushed home.
 64. Appliance for pushing cylinder against short stop.
 65. Appliance for vibrating riders.
 66. Side Guides, and appliance for adjusting them.
 67. Appliance for braking cylinder.</p> |
|---|--|

The above diagrams represent the design of some special machines built for Messrs. Raithby, Lawrence & Co., Ltd., by Messrs. Elliott, Son & Co.
The diagrams are given here because the names of all the principal parts of the machines are indicated.



than the bearing portion of the cylinder; that is, the impression part of the cylinder must not be raised too high by blankets or paper. In such a case a slur must inevitably arise, and usually at the foot of columns or the outside edges of the forme.

A hard tympan should be prepared, consisting of calico and the necessary number of sheets of paper sufficient to bring the printing surface of the cylinder to a level with the extra thickness of iron which is on the ends of the cylinder.

A sagging of the sheet in the gutters, or before it reaches the forme, often causes slurring. To prevent this two or three pieces of machine tape may be tied from rod to rod under the cylinder, moderately tight, but so that they run in a line with the furniture between the pages. Another remedy is to fasten strips of pliable card, about an inch or an inch and a half wide, to the feed board, letting them extend about an inch beyond the brass plate.

Amongst other causes of slur may be inequalities in the sizes of the bowls and rails, want of solidity in the foundation of the machine, and a lateral shifting of the feed board. No more play than an eight-to pica should be allowed between the top and bottom racks. Worn or broken cogs in the carriage may cause a slur.

The cylinder bearings must be type high. If they are in the least above type high more packing must be put on the cylinder than the beard will allow of, and this will result in slurring.

An objectionable practice is that of tacking pieces of cardboard on the bearers in a line with the slur. It will be found on removing these pieces that they have left behind on the bearers an indentation. If they ease off the pressure the cylinder bearers are either too low, or the brasses are worn, allowing the cylinder to dip.

The best method of setting the cylinder upon the bearers is the following:—Make up the cylinder to a sheet short of its full complement; get a forme of type, as big as possible; lock this upon the carriage, and place a plain sheet upon the top; at the same time place damped strips upon the bearers, pull an impression, level up the inequalities in the bearers, and note the impression obtained from the type. Continue the levelling up of the bearers, until the cylinder is pressing

evenly and firmly upon every part, and a level impression is obtained from the type.

The bearers should be tested from time to time, and any defect met by packing beneath the bearer, or by lowering the cylinder.

Care must be taken that the grippers are fixed evenly; that they do not allow the sheet or any part of it to slip; that there is no shifting of the feed board while the sheet is being taken in.

The less patching done upon the cylinder the better. Overlaying should be obviated as far as possible by underlaying.

Use the lightest impression that will give solidity in the print.

Badly seasoned paper is frequently the cause of a slur. If possible, new paper from the mill should be opened out in single reams and left to dry for some time.

In working cardboard there is often a slur on the last line. This is caused by the stiffness of the board preventing it from conforming readily to the curve of the cylinder, so that as the impression ceases the sheet flies out flat, leaving a dirty appearance about the edge. To obviate this take one or more pins, according to the size of the job, cut them off so as to make them type high or a little over, and then place them in the furniture so as to catch the end of the cardboard.

Perfecting a Sheet without Points. In perfecting or backing an octavo or 8pp. forme, the sheet, after being printed once, is simply turned around and fed to the same gripper edge and the same side lay—the latter by means of the opposite gauge. But to secure good register without points in a 12mo or 12pp. forme, when the sheets are of uneven size, the forme, after being printed on one side of the paper, must be turned around on the type bed and made ready afresh. The same gripper edge and side lay are then used. The difference lies in the structure of the two impositions. In the octavo pages 1 and 2 are on the gripper edge, while in the 12mo they are on the side lay.

The apprentice should carefully study the principle of the ductor and of its proper adjustment. He should understand, for instance, what would be the result on an ordinary ductor if the knife were screwed tight at one end and loose at the

other. Such an arrangement would cause an uneven flow of ink. If the tightness were great, the machine would be damaged, for the knife and ductor roller would be worn unnecessarily. It would also cause the knife to spring somewhat in the centre. There are, however, some formes that require more ink at one end than the other. In such a case the knife would require opening wider at that end.

The most difficult formes for printing at a cylinder machine are those the pages of which have rule or ornamental borders. All have a tendency to crease in some part of the sheet—usually the part that leaves the forme last. This may arise from various causes—the pages not resting firmly on the bed of the machine; the rules not being perfectly true, so that when the pressure of the cylinder comes upon them they move; the grippers not holding the sheet firmly its whole length; the cylinder being off its bearers; the lay-board side rods not working together; bad underlaying or overlaying; the cylinder packing being loose or baggy; a fault in the making up or locking up of the forme; the paper being out of the square at the sides; or from the paper becoming damp and cockled through changes in the atmosphere.

It may be concluded that if the crease always appears in the same place, there is something wrong with the machine, the make-ready, or the forme. If it comes first in one place, then in another, and disappears from some sheets altogether, the paper may be considered to blame. Should the forme be suspected, put half a dozen sheets of different kinds of paper, the same size as the sheets that are to be printed, through the machine. If the crease comes in the same place on each of them, examine the packing of the cylinder to see if it is perfectly flat at that particular spot. If the packing is at fault a similar crease will be found on the top sheet. Then notice the grippers opposite the place where the crease comes, and see that they do not grip the sheet too tightly, so as to cause it to bulge, or if they do not grip it tight enough, thus allowing the sheet to slip while it is being carried over the forme. If the crease cannot be traced to one of these causes it must be due to the machine, forme, or paper.

Take the machine first, and ascertain if the cylinder is travelling firmly and evenly upon its bearers. Then notice how

the lay board works; if, owing to one of the rods being worn, one side drops rather before the other and so prevents the sheet being taken in at a proper level, it can be temporarily remedied by putting some hard card between the board and the rod that is worn.

Next look to the forme. If the page is springy, take out the rule on which the crease shows, and see if it stands level. If not, replace it with another. Having made sure the crease is not the fault of the machine, the packing, or the make-ready, test the paper. Watch the side lay to see that the sheets are travelling in straight; if as they near the leaving edge they press heavily against it, the sheets are either out of square at the side or the front lay is not straight. If the sheets are out of square, turn the ream around, or have the paper trimmed square. If the edges are much cockled, the effect may be tried of fixing some cards to the edge of the lay board, so that they fall in between the grippers and assist in keeping the sheets flat and close to the cylinder. The card for this purpose must not be too thick—about the substance of an ordinary business card would be most suitable.

As much margin as possible should be allowed in such formes as large single-sheet price lists with illustrations; posters, etc. The more margin the less danger of creasing. The stouter the paper used, the better; a moderately thick, cheap, soft paper is more suitable than expensive hard paper.

Only the linen covering and paper should be used for packing the cylinder. In making ready, if the border be a separate working, the lines running parallel with the cylinder will require more pressure than those running parallel with the roller bearers. To equalise the pressure, reduce the number of sheets upon the cylinder as may be necessary to make those portions of the forme requiring the least pressure print sufficiently sharp. Then paste some strips of paper over those parts of the border needing more pressure, slightly overlapping the last two or three pieces, so as to graduate the impression and prevent them acting too abruptly. Afterwards damp and paste a sheet over the whole. This should constitute practically all the making ready required.

If the border and forme are worked together, the pressure will be nearly equalised. If the forme be an illustrated price

list, made up of blocks and movable type, the blocks should be made as level as possible by underlaying; thin paper is most suitable for overlaying, and very little paste should be used. If it be a poster, and the border and letter in fair condition, the making ready should all be done by careful underlaying—the great aim being to interfere as little as possible with the cylinder packing whether by cutting away or patching up.

Should the sheets in printing crease at the leaving edge, stout wrapper fixed along the whole length of the edge of the lay board, so that it just touches the edge of the cylinder when the board rises, and at the same time clears the grippers, may be of assistance in stopping the crease. If it still appears, and the paper be ordinary printing paper, the only remedy is to have it damped. It will then run smoothly if the forme is properly made ready, and give no further trouble. On the other hand, if it be a surface paper that will not stand damping, and is uneven at the edges, have it rolled and the difficulty will be overcome.

One method of preventing the creasing of large eight-page formes, etc., is to place on the cylinder a slip of thin card on each side of the make-ready. If this should be only a partial remedy, apply another slip close to where the crease appears. In most cases this proves effectual. Tapes placed down the gutters will often prevent creasing.

Another method is that of pasting on the cylinder a thin paper bearer of about a nonpareil in thickness and the desired length, in the margin near the wrinkle. Small pieces of wood bearers may be fastened in the open spaces of a page with good effect.

Printing upon bright enamelled and coated papers. Printing in black and especially in colours upon these papers is often very troublesome. The drying of the ink is very slow, and smudging results. This is partly due to the materials used in the ink. Some of the driers supplied by the ink makers obviate the evil; with some colours, and bronze, an admixture of Venice turpentine may be tried. Driers, however, should be used with caution, owing to their liability to make the inks dry hard and brittle.

Some of the ingredients of inks render them very sensitive to the condition of the weather. The printing is extremely

CREASING

liable to rub off. The following treatment is recommended on the ground that the ink will stand for years after twenty-four hours' drying.

The best rollers to be used are the old-fashioned ones, made of treacle and glue. To whatever colour of ink it is intended to use add, according to the number of copies to be worked, a small quantity of the best copal varnish, with a little tallow—similar to that which is used for making tallow candles. Mix well together and use sparingly.

This preparation will also answer for enamelled cards. Most inks show on such surfaces a want of solidity. The print may be rubbed off, however long they have been worked. This is probably due to the ingredients used in the preparation of the surfaces, the enamels especially absorbing the varnish in the ink, and there is consequently nothing left to hold the colour. The above preparation will remove the tendency to rub off. After use the rollers should not be left to stand in the ink, but should be cleaned with turps.

Characteristics of good machine work. The following are the points to be regarded:—

- Solidity, sharpness and clearness obtained by as light an impression as possible ;
- Evenness and regularity of colour ;
- Accuracy of register ;
- Clearness and brightness of colours and tints ;
- Absence of finger marks or set-off.

It is a great mistake to try and correct the faults of an imperfect and hurried making ready by a weak impression, and by running an excess of ink to hide the weakness. Excess of ink fouls the rollers, clogs the type, and causes the printed work to smear or set off. A sharp print cannot be had when the impression is so light that the paper only touches the ink, and is not pressed against the type. There must be sufficient impression to transfer the ink firmly and evenly to the face of the paper, even if the paper be slightly indented. The amount of impression required will greatly depend upon the condition of the type being worked ; if worn, or if from stereo plates, a moderately soft packing will need to be used as cylinder dressing. This will “give” to the

Prevention
of rubbing
off

printing surface, and enable the machineman to make a better job of bad type or worn stereo plates.

The impression that is confined to the surface is the best safeguard against the wear of type, but a surface impression can only be obtained when the type is new, and by using a fairly hard packing, with careful making ready. Good press-work is only produced by careful attention to every detail. Nor will superiority in any one point compensate for deficiency in another ; new type will suffer from poor rolling, and careful making ready will be time wasted if poor ink be used. It is necessary that all the materials should be good, that they should be adapted to each other, and fitly used. A good workman can do much with poor materials, but to neglect or comply with one condition often produces as bad a result as the neglect of all.

CHAPTER VI.

MAKING READY AND WORKING WOODCUTS AND
PROCESS BLOCKS.

IN the present chapter will be given some instructions for making ready and working formes containing woodcuts and process blocks. The directions are generally applicable to cylinder and platen machines. As a preliminary, however, reference may be made to the preparation of formes of this character before they are laid upon the machine.

Locking-up Illustrated Formes. The method of locking-up an ordinary forme of matter has been described in Volume I. If the forme, however, contains blocks some additional instructions may be necessary.

Great attention should be paid in locking-up to the justification of blocks, especially when they have reading matter running down one or both of the sides. The compositor or the maker-up may put in too much or too little white in one or more places, and this, if allowed to pass, would destroy the symmetry of the sheet. For other reasons each page should be carefully tested for errors of justification, and sometimes imperfections will need to be rectified by using strips of card-board or scale-board in the manner of leads. This is especially the case when the pages have borders or rules around them. If pages of this description are not properly justified the leads, clumps, and spaces will have a tendency to rise on the machine. This causes endless annoyance and trouble in stopping the machine from time to time in order to push down the material which blackens and spoils the sheets.

A forme of pages with rules round them requires special care. Each page should be carefully examined to see that the headlines are at the proper distance from the rules or borders. If not correctly spaced perfect register on the machine is impossible.

Care should also be taken that the corners and rules join properly. If rules with mitred ends are used see that the mitres close up perfectly. Another point to be noticed is whether the furniture is exactly right in each section of the forme, so that trouble in getting the forme to register when on the machine may be avoided. Other points are to see that the forme is perfectly square when locked up, that nothing binds, and no minor causes of trouble exist which are liable to be overlooked, but soon manifest themselves when machining is proceeded with.

In book-work consisting of illustrated catalogues the pages are liable to vary in width or length on account of the size of the cuts or the amount of matter which it is necessary to get into particular pages. It is desirable that such pages should be made to even picas in width in order to save trouble in making up the furniture. If this is not done different furniture has to be made up for some of the backs and gutters, and the page be measured to find out how much the difference should be. If, however, the pages are made up to even picas it will be seen at a glance how many picas or nonpareils have to be subtracted from the furniture to accommodate the wider pages.

When a pamphlet or catalogue makes only two or three sheets, and these are to be quired, that is, inserted one within another, special provision should be made in order that all of the pages may have an even or equal margin when trimmed. This can, of course, be done by making allowance in the gutters of the formes for the thickness of each sheet inserted. Thus, the first sheet from the centre should have a lead or two more than the centre, the second a lead or two more than the first, and so on.

Formes that are made up partly of type and partly of plates should be carefully tested with the straight-edge if a good register is required. It must be remembered that in making electrotypes plates the moulds are liable to shrink from atmospheric influences, and the face of the plates will sometimes be a trifle narrower than the face of the type page. Again, if the plates are old the wood blocks may have shrunk and the furniture will need regulating accordingly. When a forme is in duplicate, one portion—the original—being in type and

the duplicate being plates, it is better for both the machine minder and the maker-up to have the plates in one half of the forme and the type in the other. Mixing of type pages and plates should be avoided if possible.

If a forme has to be worked in two or more colours it is desirable that the same furniture should be used for each colour. The exception is when borders only or borders and headlines are to be in one colour and the body of the forme in another. By using the same furniture for each forme in two-colour jobs without borders an almost perfect register can be attained, provided the pages have been made up with reasonable care. It is well, however, to try each forme before sending to press with a sheet printed from the previous forme to make sure that the lines, words, or figures will come into the right position. It is much easier to remedy defects of making-up upon the stone than to do the same work on the machine, and avoids keeping the latter unnecessarily idle.

In formes of 12, 18, 24, 36, or 48 pages with an off-cut the head margin of the off-cut should be indicated by placing a short piece of rule at sufficient distance from the headline of two or four of the pages in the off-cut, as a guide to the binder for making his margins.

Making ready Wood Engravings or Line Blocks. The aim of the pressman should be to bring out the ideas of the artist from such in regard to light and shade, and to obtain the best effect with the least labour.

In order to do this it is necessary first to understand and appreciate the methods by which the artist desires to produce the effect desired, and secondly to possess due mechanical knowledge of the different degrees of pressure necessary to bring out the various parts of the engraving with such proper strength or delicacy as may be called for. Some of the remarks made in reference to making ready half-tone blocks apply to wood engravings and electrotypes from them. As, however, wood engravings consist mainly of lines of various thicknesses, crossed perhaps to form shades, while half-tone blocks consist of dots, the former require different treatment.

A firm, clear impression should first be obtained from the engraving. This will form a guide for cutting the overlay. The impression should enable the pressman to determine how

many sheets the overlay is to consist of. Engravings vary considerably, but an average overlay consists of four sheets, say of 20-lb. double crown. An impression of the engraving should next be taken on each of these sheets. Out of one of the impressions the extreme lights should be cut, and all hard edges softened off by paring. The solids should then be cut out of one impression, and pasted on to the first sheet. The third sheet should contain all the lighter shades, and the fourth the heavier shades.

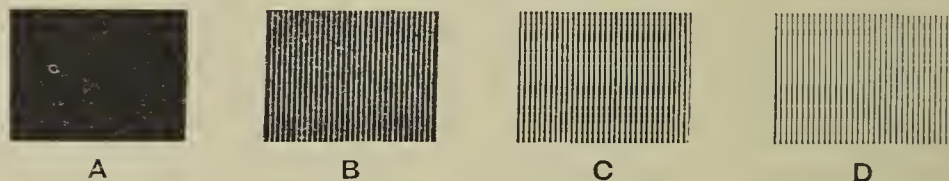
In pasting these sheets together it will be found best to put just a touch of paste here and there, in preference to pasting all over, as the latter plan has a tendency to cause the overlay to stretch in drying. Some machinemen cut their overlays for the shade exactly to size, while others cut them a little within the size required. By this latter means the variations in tone are gradually softened one into the other.

The packing of the cylinder for an ordinary job, such as a catalogue containing illustrations, may be one of three kinds. As many sheets of good hard paper may be placed on the cylinder, as, with a covering of thin calico, would equal in height the beard of the cylinder at each end. Or, the required thickness necessary on the cylinder may be made up of good hard paper and one of thin board, the latter being at the top or outside.

Some machinemen make these formes ready below the calico, which enables them to bury the overlays well beneath the packing. This method consists of pasting two sheets to the front edge of the cylinder, and placing the extra sheets in loose between these and the calico. The pasted sheets receive the over-laps and make-ready. Once the type and illustrations are levelled up, a few harder sheets are substituted for the loose ones inside, taking care not to overpack the cylinder, which is often done when hard packing is used. The packing in each case would be finished on the outer surface by placing on a damp sheet, pasted at both long edges, and then allowed to dry, thus giving a tight, smooth surface.

Every cut does not require the same treatment. One that is worn and old will be sensitive to ink and require little overlaying; a new cut is likely to require more pressure.

Making ready of Woodcuts. In an article on “The Printing of *The Century*,” Mr. Theo. L. De Vinne explains his views of the principles of overlaying. The theory may be explained by this diagram :



“Suppose A, B, C, D to be separate hand stamps engraved on wood. If the surface of the stamp marked D were inked the moderate pressure of 10-lb. would transfer these thin lines to paper. C, having more lines and offering more resistance, would call for a pressure of 20-lb. or more to ensure a good print. B is still blacker, and resists much more, requiring, say, 50-lb. to force it fairly. A, which is entirely black, could not be smoothly printed with a pressure of less than 100-lb.—perhaps more. If the pressure of 10-lb. were put on each, B and C would show weak and ragged lines, while A would be blotched all over with irregular grey spots. If the pressure were made 100-lb. or more, the lines of B and C would be hard and muddy, and D would be worn out before one hundred impressions had been taken.

“Overlaying is merely an intelligent adjustment of pressure on woodcuts, a pressure adjusted to suit the resistance, so that light lines should have little and solid surfaces much pressure. So treated, light lines will print sharp and clear, the compact and closer lines of middle tints will be smoothly grey, and the solid portions of the dark shadows will be full velvety black. The different degrees of light and shade in every woodcut require this graduation of pressure. The theory seems simple enough, but putting the theory in practice is not. Every printing machine is made so that the pressed and the pressing surfaces shall be in exact parallel, so that pressure shall be absolutely uniform in every part. If woodcuts were like the ordinary text types of books and newspapers in their equality of colour and their equal resistance to impression, there would be no need of overlaying; no more pressure would be required in one portion than in another. But woodcuts are conspicuously unequal—the thin lines, the

close lines, the solid blacks are irregularly combined and yet each must have a different degree of pressure. On simple diagrams like A, B, C, D, the result desired can be reached by pasting one or more thicknesses of paper over C, two thicknesses over B, and three or four over A. Adding thickness to the pressing surface gives the additional pressure. On a woodcut in which light and shade are intermixed the work is extremely difficult—not to be explained by words; to be learned only by experiment and the study of repeated failures. The rarity of well-printed and the commonness of badly-printed woodcuts are indications of the difficulty of the art.”

Making ready Process Blocks. On receiving the forme from the composing room, the first duty of the machineman is to see that all the blocks are made type-high. To do this properly, he should first of all take a pull of the forme with sufficient impression to make all the type readable. He will then see how the blocks stand in relation to the type. Some of them may be a little too high. In this case take the high ones out of the forme, and reduce the mounts by rubbing the underside upon a rough sheet of sandpaper.

Underlaying. The blocks which are found to be too low should be underlaid. Care, however, must be exercised in the choice of underlays. Avoid, as far as possible, the plan of placing several layers under one block. Have at hand cards and millboards of various thicknesses, and endeavour to use the one which will bring the block type-high with one underlay. This should be cut a nonpareil smaller than the block, and secured to the mount by a thin coating of glue. Paste should not be used, as it frequently causes the mounts to warp and become troublesome. The underlays should be of hard material—the harder the better; hence millboard is to be used instead of strawboard. It is of the greatest importance that the foundation of all process blocks should be solid and unyielding.

Now plane the forme gently, and give it a careful lock-up. The next impression will, perhaps, reveal a few local defects in the underlaying, and these, together with any very solid parts of the engraving should receive an additional underlay. This is best done by having an impression of the forme on a sheet of 23-lb. demy. Cut out the heavy parts and fix them

under the blocks, putting the touches of glue on the unprinted side of the sheet.

It is utterly useless to attempt to make ready a block that is not properly levelled up to type. Efficient underlaying will save hours of labour on the tympan.

Some machinememen build up blocks higher than the type, even to so much as an 8-to pica higher, and believe this to be the right course. The result is rapid wear to the fine lines and the general rounding of all sharp shades, giving the engraving, after a little use, a flat and thick appearance. Besides this the overlay cannot be kept effective, as it becomes flattened out and pressed into the tympan, with the resulting evil of drawing up quads.

It occasionally happens that wood mounts are not level on the top next to the plate, and if attempts are made to remedy this at the bottom the block rocks, bringing up quads all around. It is, of course, important that the block should stand as level as possible. If hollow in the middle or irregular at the surface the plate should be raised if practicable and an underlay put on the back of the plate. If this cannot be done without risk the plate should be brought as near level as possible by overlaying on the cylinder, care being taken to bury the overlay under as many sheets as practicable, so as to cover any sharp edges.

Whenever possible plates should be screwed, not pinned, on to their mounts, it being then an easy matter to unscrew a plate and insert an underlay.

If a large block is on the machine it is advisable to put two or three saw-cuts in it in the same direction as that in which the cylinder runs, cut to within a nonpareil of the plate. This will cause it to be less liable to rock or warp. Should a block be in use that rocks on the bed, deep saw-cuts may be made parallel with the rocking motion, about an inch or an inch-and-a-half apart, and if screws long and fine enough can be obtained, put a couple in each side and screw together to bring level, taking care to counter-sink the screw heads at the sides, so that they will not interfere with the locking-up.

Making Ready. Presuming that everything necessary has been done in regard to underlaying, making ready on the

tympan may now be proceeded with. We have already had the blocks and prepared the necessary overlays, according to the treatment required by each block. The cylinder is packed in the following manner:—If it carries twelve sheets of 23-lb. double demy, two are pasted to the front edge of the cylinder, and six are inserted between these and the fine calico, which is tightened over the whole.

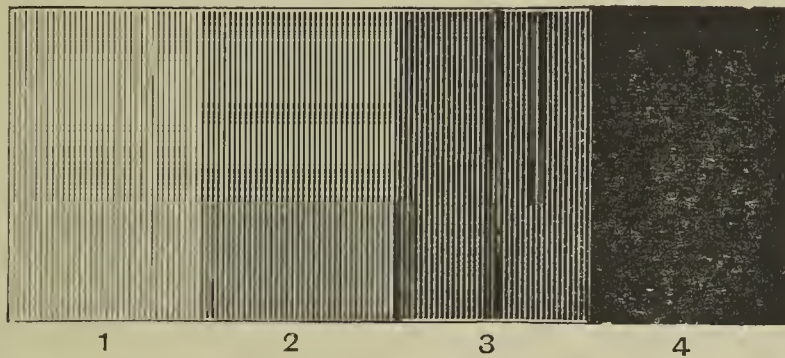
After the register has been made, and the pages and blocks passed for position, an impression is taken, the sheet stopped before it leaves the grippers, pierced with a sharp bodkin, the overlays pasted lightly on to this sheet, and the sheet pasted to the one next the cylinder, the hole in the sheet containing the overlays falling exactly over the hole in the sheet pasted to the cylinder. All are again covered up, and an impression taken to see that the overlays fit exactly. If the overlays are all right, then the patching up of the type is proceeded with in a similar manner, but the piercing of the sheets is unnecessary, as after patching up low parts, and cutting out those that are heavy, the patched sheet is pasted over, to correspond with the impression upon the sheet containing the overlays. For each sheet patched and put inside, one of the loose sheets is removed, so that the packing upon the cylinder is always kept to the one height. When all is levelled up, a few hard sheets are substituted for the remaining loose ones, and the fine calico is drawn tightly over the whole. A sheet is then pasted over the calico and a “miss” is made, upon which any further touching up is done, either to type or blocks. A thin hard sheet is next drawn over this, which serves the double purpose of protecting the patched sheet from a “miss” that may be made by the feeder, and is oiled when the work requires backing.

The advantage of this method is that thicker overlays may be used for heavy blocks, as they can be buried well below the sheets. This prevents the abrupt and decided outline caused by an overlay which is put on near the surface. The sheets between the overlay and the printed sheet adapt themselves to the uneven surface of the overlay, and assist the one tone to become lost in the next. This method is most successful in vignetted work, as the bulk of the packing is forced into the cut away make-ready below, and consequently

allows the printed surface to fall back clear from the edge of the block, which many machinemen find most difficult to get clear of. It also gives the machineman more sheets to make ready with, as he can use the whole of the loose sheets for patching or levelling up, without the fear of overpacking. The latter sometimes happens when the method of patching and damping a sheet is adopted.

The following is the system usually adopted for cutting overlays:—As some blocks have deeper shades than others, a slight difference may have to be made in the thickness of the overlay. An impression is pulled upon a fine-surfaced paper; this is termed a “reference” sheet, and is used by the machineman as a guide for his cutting. He sees at a glance just what to remove and what to retain. He pulls other five impressions upon an 18-lb. large post good-surfaced paper. In ply No. 1 he will remove all hard edges and extreme whites. Next, in ply No. 2, he will remove what he has already cut out from ply No. 1, also the first and second shades. In ply No. 3 he will retain only the deeper shades, and those apparently solid. Having arrived at the fourth impression, he will remove only the apparently solid. He will still have the fifth impression left for the further plying up of the solids if necessary. The various plys may be stuck together in two ways. For cylinders with shallow beards it is best to put on the solids first—that is, to paste the solids to the impression from which the hard edges and the high lights were removed, building up the overlay the opposite way from which it was cut out, using as little paste as possible. The other way is to build up the overlay just as it was cut out, which brings the solids to the top. As the majority of overlays have to be kept for future use, the former method has the advantage of covering up the solids and deep shades, which in the other method are apt to be torn off when the make-ready is being removed from the top.

From this description of the overlay it will be obvious that it is a piece of work that must not be done carelessly. The subject has to be considered; the effect of light and shade; what to remove and what to retain. Carelessness in this respect will produce anything but the desired effect. The shades are clearly shown in the accompanying illustration :



Do not get into the habit of cutting out shades simply because they are shades. In making ready blocks that have become worn, bring the solids well up, and use careful judgment in overlaying shade 3, as this is the shade which, when it becomes worn, fills up first. Work with as light an impression as possible.

In preparing overlays for views, etc., the aim should be to throw the subject up well. Much can be done to improve the appearance by an additional overlay on a house, a tree, or other feature intended to be prominent; and, again, a piece cut out here and there will often help to make a commonplace block look tasteful.

Process blocks are more difficult to make ready, as they are much finer, and the shades more difficult to manipulate. They will not admit of excessive overlaying of the heavy shades or excessive cutting away of the lights. Unless the utmost care is taken in the cutting, the final printing will show where it has been done. It is advisable to leave a ragged edge when cutting away sky, ground, or anything that is not line shading, as this will prevent the edges of the overlay showing.

In pasting the overlays together it is not advisable to paste all over and fasten together. Overlays thus treated can seldom be brought together accurately, as they have expanded while damp, and become unequally drawn out during the process of pasting. There is no need to cover all with paste; when all is ready for fastening the overlay together, lay the cuttings over each other and touch here and there with paste, just enough to hold them together. If not required at the time of finishing, place under a weight until wanted. This will keep them flat.

Having thus carefully made ready the forme, see that equal care is taken in working off the job. Only the best inks should be used, and a large distribution and inking power obtained. There are very few small platen machines possessing the requisite rolling power to print process blocks with simply once rolling, but cylinder machines provided with geared inkers and vibrators print them admirably. Double-rolling should be resorted to whenever it is desired to bring out the full beauty of a process engraving. Of necessity these blocks are very shallow and easily filled up with ink, consequently the less ink and more rolling the finer the effect. The essentials of process block printing are a fairly hard packing and make-ready, as little ink as possible, and plenty of rolling.

Card Overlaying is used upon certain illustrated papers and other work where considerable pressure and much ink must be furnished in particular cases, other parts being graduated, although there is scarcely time to do justice to the work in the ordinary way. A sheet of three, four, or five ply cardboard is affixed to the tympan packing. The different results are obtained by the varying thickness of this board. Where it is not cut away at all is the fullest black; where one thickness is cut out the ordinary black is shown; when two are cut out the ordinary middle ground is left; when more is detached the blanks or light parts are seen. This method is said to admit of great quickness; when an error has been committed a little patching can be resorted to.

Liquid Overlaying. This is a method of overlaying half-tone blocks. The machineman, in making ready, paints the solution on to the overlay sheet in appropriate parts by means of a fine brush, and in a few minutes the liquid dries very hard, leaving a perceptible relief.

The solution may be prepared according to the following formula :—

- | | | |
|----|---|-------------------|
| A. | Shellac varnish (one part of shellac to | |
| | two alcohol) | 1 ounce. |
| | Ammonia | 10 minims. |
| B. | Liquid fish glue | 40 minims. |
| | Ammonia | 10 „ |

Add B to A with constant and rapid stirring. The addition of fish glue not only toughens the mixture, but also prevents

it from penetrating the pores of the paper. Less of the mixture B may be used if a more horny overlay is needed, but the relative proportions of fish glue to ammonia should be maintained. Methylated alcohol is as good as absolute, for dissolving the shellac.

Mechanically-made Overlays. With a view to minimising the cost inseparable from make-ready, more particularly in respect to half-tone blocks, and the stoppage of machines, many efforts have been made to provide mechanically-made substitutes for hand-cut overlays or some means of entirely obviating the necessity for their application.

In the latter direction one of the first methods to receive recognition consists of a cylinder packing ingeniously contrived of rubber and composition with an inner layer of small, closely-woven springs. A drawback is that its use involves turning down the cylinder slightly.

Methods of making mechanical overlays are more numerous. They may be divided into two classes, the one involving a powdering or dusting process and the other a photographic method. The former requires the use of special inks, mineral powders, paper and drying materials. An impression of the forme is taken in the required ink on an overlay paper specially devised to avoid stretching or wrinkling.

According to the amount of ink borne by the pull the density and depth of the powder dusted over it varies, and thus solids, high-lights and degrees of shade are obtainable. After the dusting the impression is coated with a hardening fluid or a suitable varnish and the sheet dried, when it is ready as an overlay. Much hand work is usually involved in this process, it being necessary to scrape off undue accumulations of the powder and to touch-up generally. There are several varieties of this process on the market and a number of printing establishments put one or other of them to more or less frequent use.

Metal overlays also find advocates. In one of these a thin sheet of zinc is laid on the block for which an overlay is required, and an impression in ink taken on the metal. The plate is then sifted in dragon's blood and after protecting the back edges and other exposed parts, it is treated in nitric acid as in the ordinary method of etching zinc plates. The result

is to give an overlay embodying the variations of surface necessary to bring out the "life" of the block.

There is much to be said in favour of photo-engravers supplying overlays with their blocks, and by their adoption of one or other of the mechanical methods enumerated, two or three houses are undertaking this.

Central offices for supplying overlays to any form or make of block seem to be a possible feature of the progress of the mechanical overlay.

Process blocks should always be printed on smooth, dry, surfaced paper. The weight or thickness is not of much importance, but to obtain good results it is necessary that it should be well rolled and have a good surface. They are, however, best printed on a glossy coated paper, with a luminous black ink; or they may be worked with fairly good effect on a thick and rough surfaced paper if a blank space, the size of the block, is first of all impressed upon the paper, in the manner of printing copperplate engravings.

Much of the success of printing process blocks is attributable to a judicious selection of ink, rollers, and paper. All of these points will be dealt with hereafter under their respective headings. It is of great importance also to use the proper kind of machine.

Register. This is a point of the greatest importance, and the machinist should endeavour to learn the most correct expedients for securing it.

Modern machines of the Wharfedale type are fitted with push-back action to the cylinder. The action is simple. The cylinder travels past the "home" position, and is then pushed back to its proper position against a catch, by a connecting rod and cam. This is a great advantage over the old machine, for the cylinder is bound to register.

The action of the grippers, feed board, and gauges, however, largely influence the register. There are two chief dangers to guard against when working a register forme. They are (1) the slipping in of the sheet when the board rises and the gauges drop; (2) the "sagging" of the sheet before it reaches the forme, and sagging in any hollows, subsequently, such as the gutters between the pages. A good method of preventing the first is to fasten a piece of

rough paper, such as ream wrapper, on the feed board. It should reach from the back edge of the board to beyond the tips of the smoothers, or fingers. Loosen as many of the fingers as are not necessary for the feeding in of the sheet. Should the sheets be thin, and the weight of the fingers too heavy, cut some strips of card and fasten them on the back of two or three of the fingers. These strips should reach to within a nonpareil of the front edge of the board, and rest lightly on the sheet. The tips of the fingers should not be fastened, but if about an inch is allowed the weight of the card can be adjusted on the sheet. The sheet should be fed in as soon as the gauges rise. The back edge should not be "tipped," for if the sheet is not perfectly flat when the board rises, register is out of the question. The sheet is bound to slip in.

Machines for printing half-tone blocks should be capable of meeting four necessities :

1. Immense power, because it is highly important that the impression taken should be so powerful that all the ink deposited on the engraving will be lifted off by the paper at each printing. If any ink is left behind, clean and clear printing is impossible.

2. Rigid and square impression, because the slightest deflection or rubbing movement will impair the sharpness of the impression and tend to destroy the engraving. Perfect rigidity gives exact register—a most necessary requirement, especially in colour printing.

3. Perfect distribution. A half-tone will carry only the merest film of ink, and this must be refined and stretched to its ultimate limit to get the full effects of light and shade.

4. Scientific and separate inking of the forme, because the ink must be laid on the engraving swiftly and evenly; if the same rollers have to refine or distribute the ink and supply the forme they lack time to do it efficiently, as one operation or the other is suspended half the time taken for each printing.

To preserve Half-Tone Blocks. After printing, and when washing up the forme, make sure that no potash, lye or soda remains on the blocks, but clean with a pure bristle brush and benzoline or turpentine, and dry (gently dabbing—not rubbing)

with a linen rag free from lint, finishing off by rubbing with the palm of the hand. When dry, they may be rubbed over with mutton fat or solid paraffin, or brushed over with melted beeswax. A much cleaner and more effective method is to coat them with the composition called D.M.V., supplied by Raithby, Lawrence & Co., Ltd. It is easily applied and quickly removed. Blocks should be put away in a dry place without wrapping up in paper—paper frequently contains chemical matter, which, when brought into contact with zinc, causes it to corrode.

CHAPTER VII.

SOME TYPICAL CYLINDER MACHINES.

OF recent years there has risen a demand for a much improved style of machine of the stop-cylinder pattern, and one capable of giving better inking than the ordinary Wharfedale. This demand has been largely caused by the increasing use, in illustrated work, of process blocks.

In some of these machines a cylindrical system of distribution is substituted for the table system. Instead of the duct placed at the end of the machine, distributing being done on a flat table—from which the inkers have to take their supply of ink—the duct is placed above the carriage, and the distributing and inking rollers are grouped in the form of a pyramid, with inkers at the base. By this arrangement there is secured a continuous flow of ink from the duct to the forme, whereas with table distribution the supply taken up by the rollers is depreciated more or less before the inking rollers have covered the forme. The circumference of a distributing roller, only $3\frac{1}{2}$ inches in diameter, is, it should be remembered, more than $10\frac{1}{2}$ inches, so that a large distributing surface can be obtained in a small horizontal space.

In covering a solid double demy forme, the ink supply is greatly diminished when the rollers have covered half the forme, and one side is therefore better inked than the other. Of course, it is only a thin line on the periphery of the roller that comes in contact with the forme, and obviously this thin line can carry but a small portion of ink, one that is easily exhausted. With the pyramidal system this is obviated. The supply of ink is replenished from the duct, and when any given point of the roller's periphery comes in contact with the forme a second time its ink supply is equal to that at the first contact.

In other machines, while the table system of distribution

is retained, greater efficiency is secured by an improved arrangement of the distributing rollers, and by increasing their number and dimensions.

Two machines of this class may be described as typical ones. Several engineers produce machines bearing certain resemblances to them.

R. Hoe & Co.'s Stop-Cylinder Press. This machine is specially designed for producing the finest quality of woodcut and colour work with great delicacy of impression and accuracy of register.

The side and cross frames are so proportioned in regard to material as to contribute to the rigidity of the machine without any unnecessary weight or clumsiness. The bed is driven by a crank, and starts and stops without noise or jar. Hard steel is used for shoeing the bed, which runs on tracks of steel.

The impression cylinder is stationary while the sheet is being placed, the grippers closing, and the drop guides being withdrawn before it starts. The cylinder wheels gear directly into the racks on each side of the bed, and are driven by them, so that perfect register is secured. The utmost possible support is given at the point of impression, by vertical pillars, resting upon a solid base. The racks and cylinder gearing are cut in the most accurate manner, and work with smoothness and register, without jar or vibration.

A patent brake causes the impression cylinder to stop without jar and to stand without tremor until the sheet is taken by the grippers. A brake gives the machine minder entire control of the machine. An improved cam motion greatly increases the speed, without injury to the machine or detriment to the quality of the work turned out by it. A special reversing motion has been added. The cylinder shafts are forged with a special brand of steel, which, according to the manufacturers' long experience, is the best adapted to the purpose. The working parts, including the bed friction rollers, are all made of hardened steel, the gearing is made of special iron, and the machine is of great strength throughout.

Inking Arrangements. In four of the ten sizes made, which range from a bed space of 20 by 25 inches to 29 by 42 inches, there are four forme rollers; in the others, which extend to 47

by 65 inches, there are six forme rollers. The ink table is of cast iron, and is warranted to remain always true and level. The distributing cylinder is of polished steel, and, with the

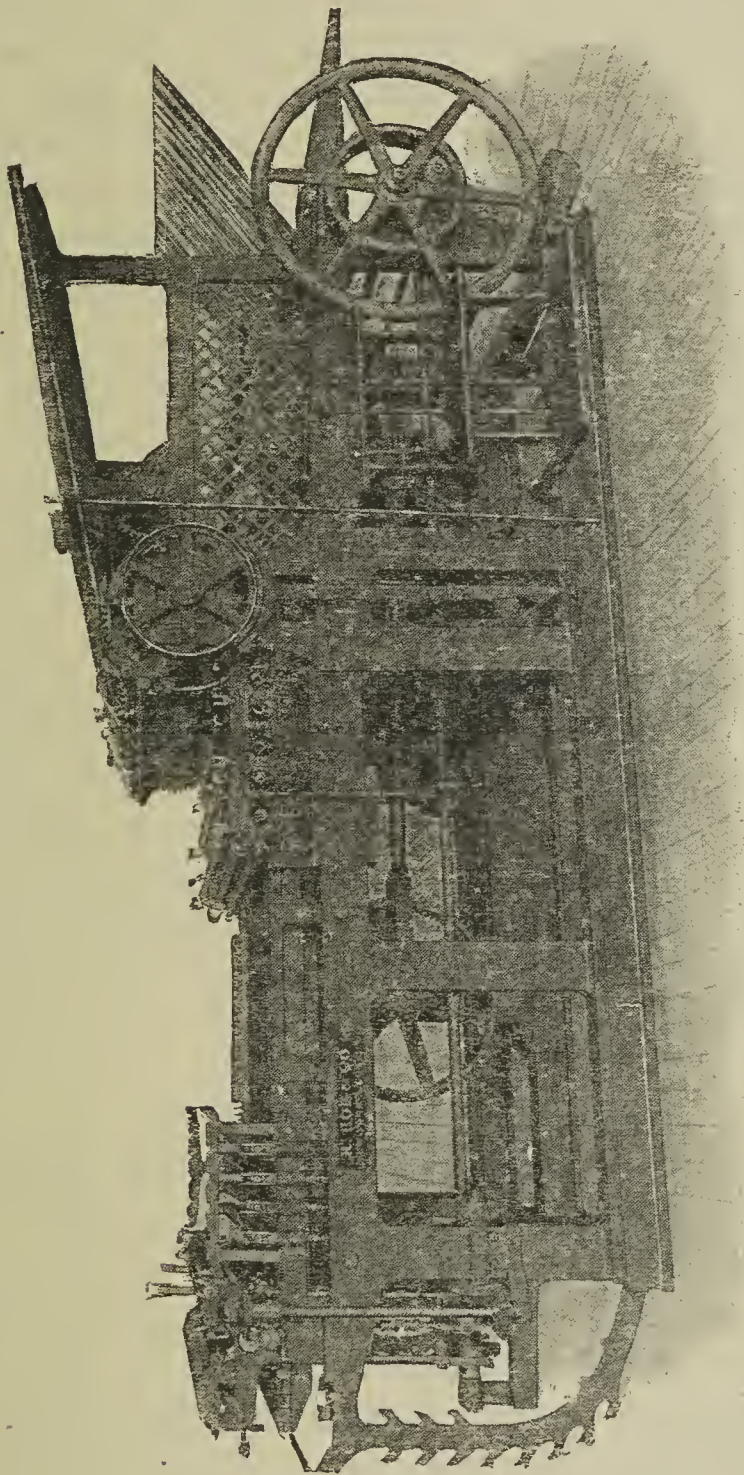


FIG. 24. STOP-CYLINDER PRESS.

extra composition rollers, receives the ink from the duct and transfers it to the ink table. All the various sizes, except one, have the cylinder distribution.

The distributing rollers run in a hinged frame, which can be quickly raised to allow the forme rollers to be removed and replaced without deranging their adjustment. The forme rollers are not driven by gearing, but by the contact of the distributing rollers above them, the surfaces of which always run at the same speed as the type surface. The table distributing rollers can be set parallel, or at any angle required. They are of wrought iron pipe, with steel journals welded in.

When ordered, the machine is so arranged that the bed may run either once or twice before the cylinder moves, thus passing the forme either two or four times under the inking rollers, as desired, before taking the impression.

A patent delivery cylinder takes the printed sheets from the impression cylinder, without the use of cords or tapes, and sends them by a set of independent and adjustable cords down in front of the fly. The latter has sharp-edged fingers with patent star wheels in order to prevent smear. Any one of the fingers can be quickly changed in position.

Several special high-speed printing machines for producing high grades of printing in a superior manner at greatly increased speed have also of late been introduced. Their superiority is claimed to lie in their perfect register, improved ink distribution, strength of impression, smoothness of movement, uniform speed of bed, and uniformity of speed of bed and cylinder. Such machines are used in an increasing number of large establishments, especially for illustrated work.

THE DRUM CYLINDER PRESS.

Typical of another class of cylinder machine largely in use is the *Standard Drum Cylinder Press* built by the Babcock Printing Press Manufacturing Company of New London, Connecticut, who also make the *Optimus Two-Revolution Press*. It was the pioneer in this country of drum cylinder presses. The drum cylinder press differs essentially from the Wharfedale in the fact that its cylinder rotates continuously and is not stopped between each impression. In this respect it is like a Two-Revolution Press, but differs from the latter in the fact that its cylinder is of extra large diameter and makes one complete revolution for every impression. That is to say, the cylinder makes a complete revolution while the

type bed is travelling backwards and forwards once. On one side the cylinder is of slightly smaller diameter than the other and this permits of the return of the type bed. This continuously rotating cylinder gives a smoothness of motion which is very noticeable. Also its large diameter gives a more platen-like impression and saves wear and tear upon the type. There is no impression trip, the cylinder being held in simple fixed bearings.

The type bed is carried by two full length tracks which are faced with steel and the bed itself is also shod with steel. These two full length tracks are carried by a massive centre girt immediately under the impression, and this centre girt also carries two adjustable bowl tracks between the full length tracks so that it is an easy matter to maintain a perfect impression.

The sliders between bed and tracks are positively controlled by a special spiral mechanism which ensures that they always occupy their correct position in relation to type bed and tracks, another good feature being that this spiral mechanism permits of alteration of the point of reversal of the sliders so as to save "pitting" the tracks.

The bed is driven to and fro by means of a simple patented mechanism in which has been perfected the mechanism first designed by Napier. A flat rack is carried in a substantial hanger fixed to the under side of the type bed and a pinion fitted to the end of a deflectible driving shaft alternately engages with the upper and under sides of this rack, thus driving it in opposite directions at an even speed. There are special shoes for reversing the position of this pinion and large air buffers with automatic valves assist the reversal of the type bed. The driving shaft is rendered perfectly deflectible by means of a universal ball-and-socket joint which ensures equality of rotation whatever angle is assumed by the deflectible part of the shaft.

The inking arrangements consist of a pyramid of rollers which perform the double function of distributors and inkers. There is no ink slab. The fountain is furnished with flexible steel knife and the vibrator puts the colour upon a steel reciprocating rider which in its turn is in contact with another composition rider. This again is in contact with another

reciprocating rider driven by a rack on the bed, and this rider in its turn drives the two inkers. There is also a distributing drum which makes contact with the second inker. It will be seen that by this means the ink taken from the fountain travels direct to the forme in one operation, and as the result of this the inkers are fully charged at all parts of their travel, the parts stripped of their ink by the forme receiving a fresh supply immediately from the more heavily charged rollers above. In effect, the forme is covered at all points by four fully charged inkers.

Delivery is effected by means of a fan at the rear of the press, the sheets being delivered printed side up without the use of tapes. After they are printed they pass over a skeleton drum, of which all the wheels are adjustable so that they can be moved into the margins if necessary. This drum delivers them on to a perpendicular fan, of which the sticks are all adjustable and fitted with star wheels, and this flyer drops them on the delivery board, which is furnished with a sheet jogger. This press is made in five sizes, ranging from royal to quad demy, and in two models, namely, the double crown and quad demy "Express Standards," it runs at the enormous speeds of 3,600 and 2,600 impressions per hour respectively.

With the beginning of the 20th century British printing machine engineers have shown themselves much alive to the needs of printers in respect to machines equal to the constantly growing requirements of the public in respect to pictorial and general colour work. Thus it comes about that practically all the larger houses offer one or more styles of cylinder machines specially designed to produce thoroughly good work at an increased rate of speed. These machines differ chiefly in matters of detail. There are, however, certain amongst them which may be referred to as embodying what are considered to be useful features successfully contributing to an effective class of machines. It is impossible to mention all these, but the following may be referred to as showing representative supplies by well-known firms of engineers:—

"*Bremner*" *Stop-Cylinder Machines*. Amongst the latest and best cylinder machines may be mentioned two by the Bremner Machine Co., Ltd., Otley. One of these is a top-feed front delivery press—terms descriptive of its characteristic features.

In this the sheets are fed and delivered printed side up without flyers, and no runners or tapes touch the printed side of the sheet. Distribution is obtained by a pyramid of geared rollers; all parts are readily accessible; adjustable air buffers are provided on the larger size machines. The solidity and accuracy of this machine equip it for the finest work. The rate of speed on double demy size, for instance, is 1,800 impressions per hour.

The Victoria Bremner Machine, by the same makers, is of the under-feed class, and is also specially built for half-tone and colour printing. A cross rail under cylinder to assist in imparting rigidity, reciprocating geared riders to both inkers and distributors, air or spring buffers, and a working rate of 1,800 per hour are features of this machine.

The Perceler of Wm. Dawson & Sons, Otley, has much the appearance of a two-revolution press, but differs very considerably from that form of machine. The cylinder is directly geared with the table. The feed is overhead, and the delivery on tapes, the sheet passing between runners on tapes, which carry it to delivery without touching the printed side. This is a speedy machine, with good roller and distributing power, and is made in sizes from double demy upwards.

The Summit Stop-Cylinder Machine is also a variation of the Wharfedale type of machine designed to produce high-class work at a rapid speed. It is made by Wm. Dawson & Sons, Otley.

The Summit is a stop-cylinder machine with an overhead feed and carrier form of delivery. As with the "Perceler" by the same engineers, this possesses a cylinder of comparatively small diameter, and in its general aspect varies considerably from the ordinary Wharfedale. It is made in double royal size and downwards. Register is a special feature, whilst the speed is rated at from 15 to 30% above the Wharfedale proper. Delivery is made in full view of the feeder. The forme is accessible without disturbing rollers or feeding board. The cylinder makes slightly more than one revolution, in order to run the sheet into the delivery before the cylinder is pushed back.

Elliott and Defiance Cylinder Machines, made by Elliott & Co. (Otley), Ltd., rank as amongst the very foremost of

the Wharfedale class, and are thoroughly well adapted for the finest work. Amongst the various styles made, the cylindrical inking machine—a self-explanatory term—may be selected. This machine is made in sizes double demy and upwards. It possesses four cross rails, one centre rail arched, and four runner rails; in fact, heavily constructed with powerful support under the cylinder. Air buffers are fitted. The rollers, distributors and ductor are grouped together. Distribution is adjustable sideways; four rollers, 4 inches diameter each, cover full forme. A cylinder check also checks feedboard, grippers, ink and return bar to cylinder at the same time, and is actuated by both hand and foot. Balanced flyers are provided. Whilst still easy for feeding, sufficient slope is given to the feedboard to keep the sheet to front lays; side lays are automatic in action. Dead register and rigid impression are ensured.

The Special Wharfedale of Payne & Sons, Otley, is designed to meet the competition of two-revolution presses. It possesses increased rolling and distributing power with strengthened parts, and in respect to speed is probably the fastest of all the Wharfedale machines. The improved framework includes a bed plate, four bowl rails cast in one piece, and the whole bolted together to ensure perfect rigidity. The flyer cylinder includes a series of aluminium skeleton wheels, devised to minimise the risk of offset.

The firm of Payne & Sons (Otley) Ltd., make another up-to-date Wharfedale machine under the title of *The Perfection*. This retains the Wharfedale movement with its acknowledged advantages, but possesses a variety of new features. The double crown runs at 2,500 per hour; the quad crown at 1,800 per hour. The delivery mechanism is well devised alike for carrying sheets away and for allowing access to the forme, whilst being out of the way of the feeder. The machine-minder can see the sheets during their full course, and sheets are delivered printed side up. These machines are fitted with geared distributing apparatus controlling a very complete system of inking.

The same house makes a two-revolution perfecting press devised to give great speed and yet retaining long wear and tear. This also is fitted with geared inking apparatus and

geared distributing apparatus, and possesses a geared set-off device.

Interleaving Machine. This is also made by Payne & Sons, Otley. The delivery apparatus is driven by direct gear with the cylinder wheels, the sheet being seized with travelling grippers after printing. These carry it to the delivery board and drop it face upwards without touching the printed side. In addition to this is an ingenious arrangement for feeding interleaving sheets direct into the delivery itself, the interleaving sheet being seized by separate travelling grippers which follow in the track of the printed sheet, and drop the interleaving sheet on to it. The interleaving board can be removed when printing work not requiring interleaving.

The Koenig & Bauer Stop Press, for which Hunters, Ltd., London, are agents, is typical of the German flat-bed single-revolution machine. The method of driving the type table is the familiar sun and planet motion—or, in engineering circles, White's parallel motion—and is practically a horizontal crank movement. The inking is of the pyramidal order. There is no ink slab, the duct being placed at the top of the set of rollers and riders next to the cylinder. Register, movement, and inking are all of the most satisfactory order.

The Bremner foolscap Rapid (Bremner Machine Co., Ltd., Otley) is constructed on what is known as the "coffin" principle, that is, the cross frames, bowl tracks, rack rails and wheel shaft brackets are all cast in one piece. This is done to get the maximum amount of strength and rigidity. The machine runs almost noiselessly at 3,000 impressions per hour.

All the gearing is cut from the solid. The table bowls and cylinder are ground dead true in a machine built specially for this work. Geared inkers of ample dimensions with reciprocating steel riders are provided. There is micrometer adjustment to both side and front lays; this adjustment can be safely made while machine is running.

The angle of the feed board is an ideal one from a feeder's point of view. An arrangement is also fitted which prevents any motion of the front lay bar until the grippers have hold of the sheet.

The flyer cylinder is of the sectional type, and these sections with the tape runners and flyer laths can be put in any position desired.

The cylinder automatically rises at every return of the bed, and then lowers again. The raising can also be done at will by the pressure of a pedal—useful if a sheet is badly laid, it being thereby delivered unprinted and undamaged. The same arrangement allows for inking up before printing. This press is exceptionally strongly built; the bed runs on four tracks; the cylinder is of immense strength, withstanding all pressure necessary for cut work.

The press can also be fitted with an attachment for printing from the roll. In general it may be described as producing the finest grade work at a very high speed, and as such suitable for the best class of illustrated magazines, catalogues, and kindred work.

CHAPTER VIII.

THE TWO-REVOLUTION MACHINE.

IT has been already explained that in machines of the single-revolution, or Wharfedale type, the printing cylinder is brought to a standstill after each revolution, to allow of the backward traverse of the bed. In machines of the two-revolution class the cylinder makes two revolutions to the one forward and backward traverse of the bed. The cylinder revolves in gear with the bed on the forward traverse, and is lifted out of gear for the backward traverse.

In other words these machines differ from the stop-cylinder press in that the cylinder is in continuous revolution, making two revolutions to each impression. The arrangement ensures greatly increased speed. Machines of this class are familiar to printers under such names as the Miehle, Optimus, Hoe, Cottrell, Century, Furnival, Elliott, etc.

Another point of difference is that the cylinder derives its motion directly from the main driving shaft. The cylinder is caused to rotate continuously in the one direction, which is the reverse to that of the Wharfedale cylinder. Consequent on this, the sheets are fed in from above. The laying-on board is on a level with the top of the cylinder, and is inclined slightly upwards therefrom.

In the best machines of this class, the superstructure is erected upon a very substantial foundation, or base plate, having heavy cross rails, designed to carry an exceedingly heavy impression, and yet rigidly maintain, in perfect alignment, the moving parts when in operation. The side frames are cast of solid metal and firmly bolted to the bed plate, and these partially support the tracks, or bowl rails, on which the type bed travels; the other supports are on standards secured firmly to the bed plate. The bed movement consists of an upper and lower rack, carried in a rack frame, having straight "shoes" at each end. The crank wheel has teeth

cut on its periphery, and these wheels engage alternately with the upper and lower racks, always with the upper one and directly under the type bed when printing, the lower one when moving in the reverse direction. At each end of the stroke the crank pin comes into play, working through the straight shoe, and giving a perfect retarding and accelerating movement. The crank gear is secured to a strong steel shaft, supported on heavy bearings, rigidly bolted to a moving cradle which vibrates from one rack to the other. This peculiar bed movement is the cause of the ease and quietness of the working even at the highest speeds. The type bed runs on small anti-friction rollers, carried on light steel frames.

This method of driving ensures an even and steady speed of travel, and there is a short stay at the ends. The momentum of the carriage is, however, considerable. To withstand this air buffers are provided at each end of the frame, the action of which is to soften the shock at the ends of the stroke, and at the same time give the carriage an impulse for its return.

The impression cylinder is of very much greater strength than formerly obtained in English practice. The central shaft is of extra large diameter, and is supported in perfectly fitting boxes which have a slight up and down movement to bring the cylinder on and off the impression. This is accomplished by a powerful eccentric motion, the up and down movement being governed by a cam. It is arranged so that the impression can be thrown off at the will of the operator, by placing his foot on the trip pedal.

The ink-distributing, or angle rollers are positively driven, and have at all times synchronous movement with the ink table, and when it is away from them they are still distributing ink over each other. This arrangement increases effective distribution of ink, and saves the rollers, as they do not abrade, and break off the composition from the stock. The inking, or forme rollers are arranged on the "pyramidal" system. They are four in number, arranged in two pairs. Over each pair is a steel vibrating cylinder. On each of these rests a composition roller and on and between these rollers another light steel roller connects the whole in a pyramid. By this plan there are nine rollers in connection with each other, giving a large distribution of finely divided

ink over the forme. Any particular roller is readily accessible, either for adjustment or removal, and all the forme rollers, or inkers, can be handled by one person from the feed side of the machine.

The printed sheets are delivered at the front end of the machine directly over the ink duct. The forme is put on at the rear, where everything is clear for that purpose. The sheets are laid to the guides on the top of the machine. The newly printed side of the sheet never comes in contact with anything to smut or blur it.

The advantages of the two-revolution principle are greater steadiness in running and a higher speed of feeding. Machines on this plan produce better and finer work at a much higher rate of speed than machines with the stop cylinder on the usual Wharfedale principle. The feeding board being overhead permits of better light and more rapid and easy feeding than the low board. As the cylinder makes two revolutions the next sheet can be fed into the front gauge closely upon the former, which effects saving of time.

The following is a summary of the points which distinguish the stop-cylinder (indicated by S.) and the two-revolution (indicated by T.) machines.

S. The cylinder stops after each impression, and remains at rest until the carriage has returned to the original starting position.

T. The cylinder is continually in motion while the machine is at work, and makes two revolutions for each sheet printed.

S. The rack wheel travels forward and backward while in gear with the racks.

T. The rack wheel revolves continuously in one direction.

S. The cylinder is driven by the carriage.

T. The cylinder is driven by independent gearing from the driving shaft.

S. The sheets are fed in from the bottom of the cylinder.

T. The sheets are fed in from the top of the cylinder.

S. The feed board rises, the lays drop, and the grippers take the sheet.

T. The lays are attached to the frame, and removed out of the way when the grippers seize the sheet.

S. The distributing rollers are each in a separate fork.

T. The distributing rollers are arranged in pairs, with a polished steel tube roller between them, geared to run continuously.

Several kinds of machines of this class are manufactured, but it is not necessary to illustrate more than one of them. We select the two-revolution press of R. Hoe & Co., which not only embodies the general principle, but comprises several improvements peculiar to itself.

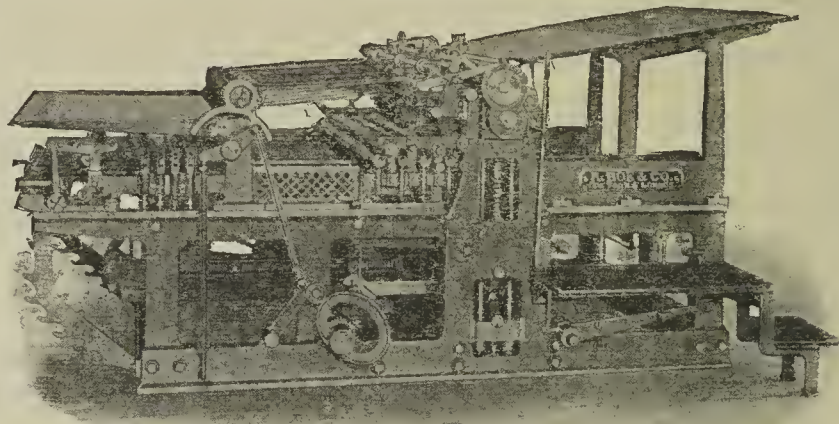


FIG. 25. THE TWO-REVOLUTION MACHINE.

The machine is designed especially for printing illustrated newspapers, periodicals, and rapid book-work. It runs at a high speed with accurate register and excellent distribution. The bed and cylinder are both actuated directly from the main shaft and both have a positive and independent motion. The mechanism for driving the bed comprises the universal joint shaft, bevel pinion, and rack. The friction roller frames are geared to the bed and the motion is smooth and noiseless. A segment on the cylinder gears into the rack on the bed, ensuring unison of movement and perfect register. The reversing motion enables the feeder to stop the machine and run it backward without leaving his place.

The delivery cylinder takes the printed sheets from the impression cylinder without the aid of cords or tapes, and sends them by a set of independent and adjustable cords down in front of the fly. The latter has sharp-edged fingers with star wheels to prevent smutting. Any one of the fingers can be quickly changed in position.

Some machines have a front delivery instead of the delivery cylinder. It delivers the sheets printed side up, and having

no delivery cylinder or fly, the rear of the machine is open, and the forme can be readily adjusted. For some kinds of work, however, it is desirable to have the fly in front of the machine, delivering the sheets printed side down, and the machine can be adapted accordingly.

Inking Arrangements. The distributing rollers run in hinged frames, which can be quickly raised to allow the forme rollers to be removed and replaced without deranging their adjustment. The forme rollers are not driven by gearing, but by contact with the distributing rollers above them, the surface of which always runs at the same speed as the bed. The table distributing rollers can be set parallel with each other, or at any angle required.

The method of cylinder distribution can be applied. A cylinder with extra composition rollers receives the ink from the fountain and transfers it to the ink table. A trip is arranged to raise the impression cylinder from the bed while the ink is being worked up on the rollers.

The Miehle Two-Revolution Press. As a standard machine of the very highest class, the Miehle is widely in use. Our illustrations readily offer in brief the chief features of its design and construction. The press runs at great speed—the highest amongst sheet-fed flat-bed cylinder machines—and in all respects is designed to produce the highest class of colour, half-tone, book and magazine printing. Amongst some features of particular interest to users may be mentioned the following :—

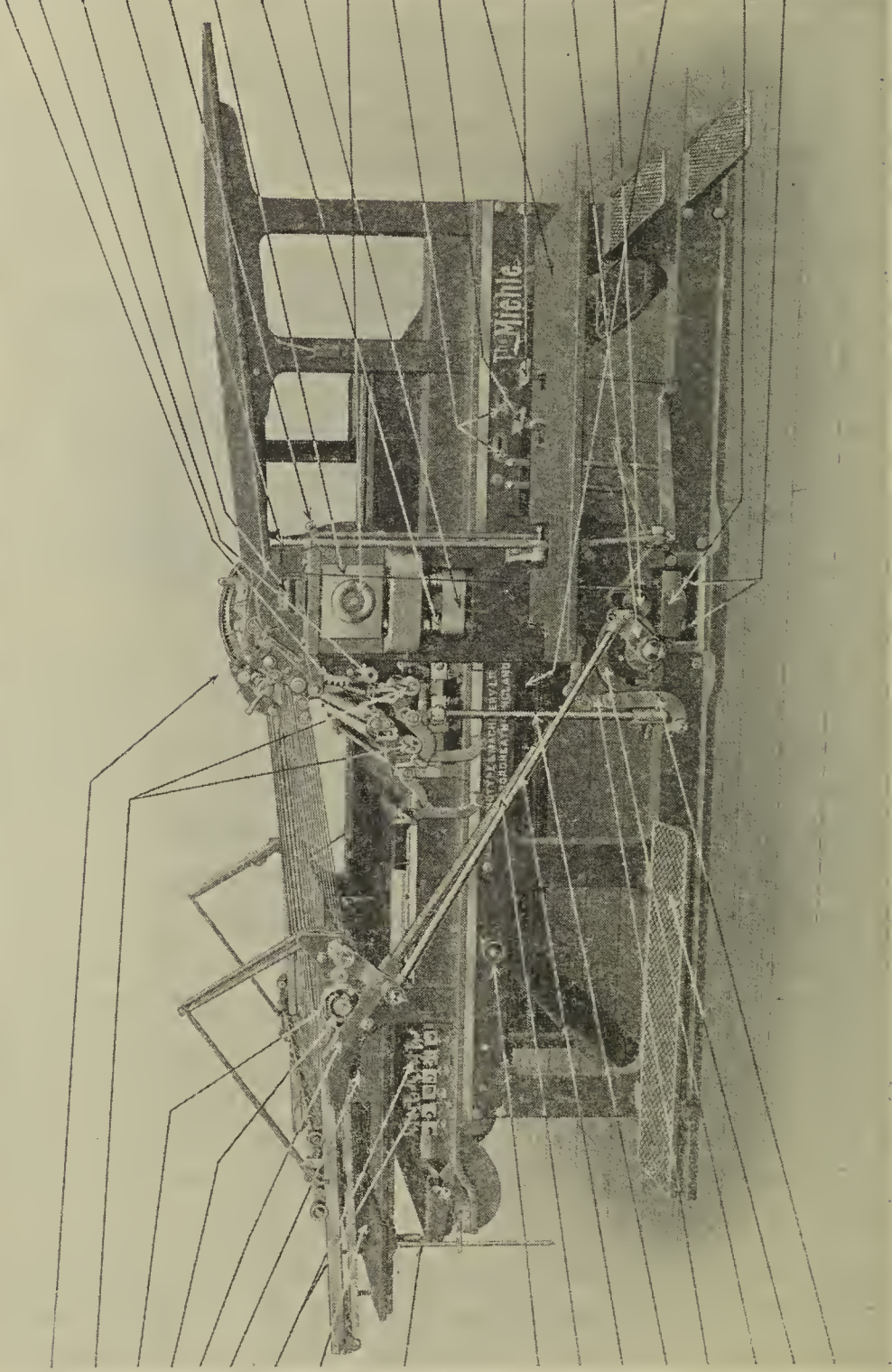
Perfect register is a prominent feature of this machine. To this end, a movable brush is placed in front of the cylinder as near to the forme as possible, which forces out all the air between the sheet and the cylinder. The utility of this device is most marked when full-size sheets are passing through the machine at high speed.

The bed motion gear is moved laterally into the upper and lower racks (the latter being positioned on either side of a vertical line), and the air-buffer arrangement ensures the maximum of compression with a minimum of resistance.

The air buffers are four in number—two at each end of the machine—and take the air at each stroke of the bed. These buffers work automatically.

In regard to feeding, being a two-revolution machine, ample

Gripper Motion and Feed Guides.
 Forme Reciprocating Rollers.
 Fly Sector Guard.
 Fly Sector
 Fly Delivery Raek (Invisible).
 Sheet Push-off Arrangement
 Geared Angle Rollers
 Jogger Blades
 Delivery Board Support (when lifted).
 Delivery Connecting Rod Rest Roller (when using Fly).
 Fly Delivery Rod and Spring.
 Delivery Connecting Rod Reciprocating Roller Shaft
 Fly Cam Roller
 Fly Cam.
 Long Side Step
 Fly Cam Lever.



Register Segment.
 Shoe Fly Cam Roller.
 Counting Machine.
 Belt Striker Handle.
 Air Release Valve Handle.
 Cylinder Boxes (Bearings)
 Cylinder Springs.
 Cylinder Springs Adjusting Block.
 Cylinder Take-up Washer
 Angle Roller Belt Tighteners.
 Brake Pedal.
 Foot Board
 Impression Trip Pedal.
 P. S. U. Delivery Connecting Rod Lower Lever
 Impression Eccentric.
 Angle Roller Driving Belt
 Impression Eccentric Block.
 Impression Rods and Adjusting Nuts

MIEHLE TWO-REVOLUTION PRESS—FEED SIDE.

Ink Table

Type Bed.

Cylinder Gear

Cylinder Gear Guard

Feed Board.

Feed Board Hinge Screw

Forme Reciprocating
Roller Lifting Hook

Cylinder Setting Screws

Intermediate Gear Guard

Tool Tray

Belt Fork

Fast and Loose Pulleys

Foot Board

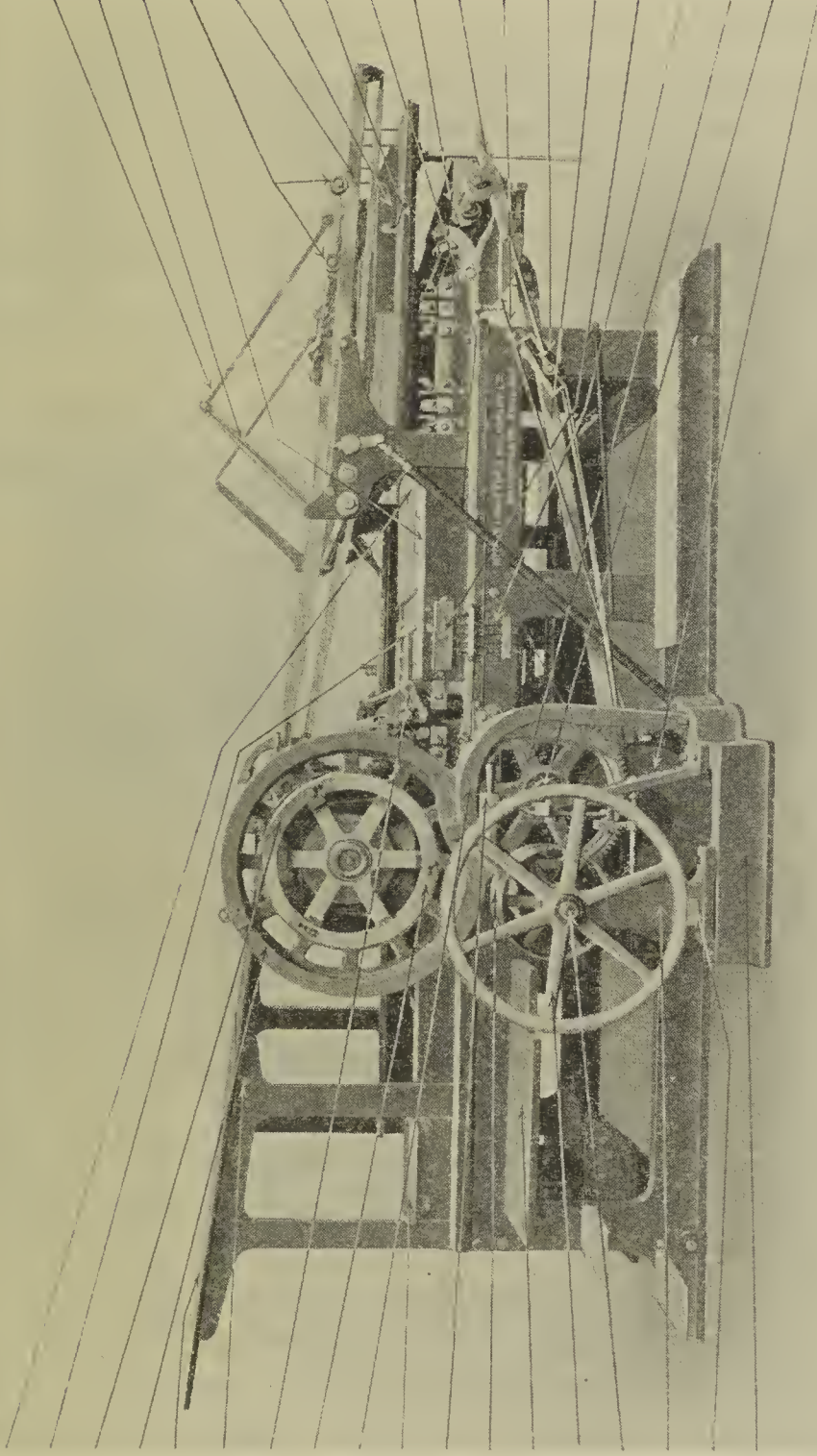
Hand Wheel on Driving
Shaft

Driving Shaft

Driving Shaft Pedestal.

Brake.

Driving Shaft Base



Delivery Carriage Link

Delivery Carriage Arm
Roller Rests.

Delivery Carriage

Delivery Carriage Way

Jogger Blades.

Delivery Board.

Fly Counter-balance Rod
and Spring.

Ink Fountain.

Ink Feed Rack Guard.

Ink Check (in connection
with Trip).

Ink Feed.

Vibrator Connecting Rod.

Oil Reservoir

Sight Oiling Arrangement.

Cylinder Intermediate
Gear.

Bed Rack Gear and Crank
Shaft.

Impression Cam Gear

MIEHLE TWO-REVOLUTION PRESS—GEAR SIDE.

time is available for laying the sheets to the guides—a matter of great importance in the production of dead-register work. Without stopping the machine, the cylinder can be checked when necessary by a foot trip, the feeder thus having both hands at liberty.

The ink supply is automatically checked when the cylinder is tripped, and the great inking power is reinforced by a pyramid roller, making a complete unit of nine rollers, which supply the forme with ink at each stroke of the bed.

With regard to sheet delivery, printed-side-up and fly delivery are provided, either method being quickly put into action as required.

Tandem Miehles. Miehle presses are also used in tandem, coupling up two or more machines for the production of colour work. Tandem units may be run independently or connected up to the number required.

The Koenig & Bauer Two-Revolution Press. One of the most noteworthy and most perfected of its class is the Koenig & Bauer Two-Revolution Press. In the latest type a combined table and cylinder inking unites the advantages of both systems without concurrent disadvantages. The grouped table distributors and forme rollers are geared, the inking and distributing arrangements in general being wonderfully perfect. A carrier delivery is provided in which the sheet is held by the grippers during the whole period of impression, ensuring a clean print of the full forme. The sheet is then carried forward printed side up and laid on the delivery table.

The freshly printed side of the sheet does not come into contact with either tapes or bars, and thus smearing is prevented.

THE OPTIMUS TWO-REVOLUTION PRESS.

The Optimus Two-Revolution Press may be selected for description as noticeable for the strength of its impression, the excellence of its inking arrangements and the perfection of its delivery. It is built by the Babcock Printing Press Manufacturing Company, of New London, Connecticut. As its name implies, it has a cylinder which makes two revolutions per impression, one for printing and one for delivery, and it is

a top feed front delivery machine—that is to say, a press where the sheet travels forward all the time. The type bed, which is heavily ribbed, is supported under the impression by two full length tracks and four supplementary wheel tracks, two placed inside the full length tracks and two outside. All six tracks are carried by a massive centre girt. The under side of the bed and the full length tracks are faced with steel, and the sliders are controlled by a special spiral mechanism described in the note dealing with the Babcock Standard. The supplementary wheel supports each consist of three adjustable bowls about 5 inches in

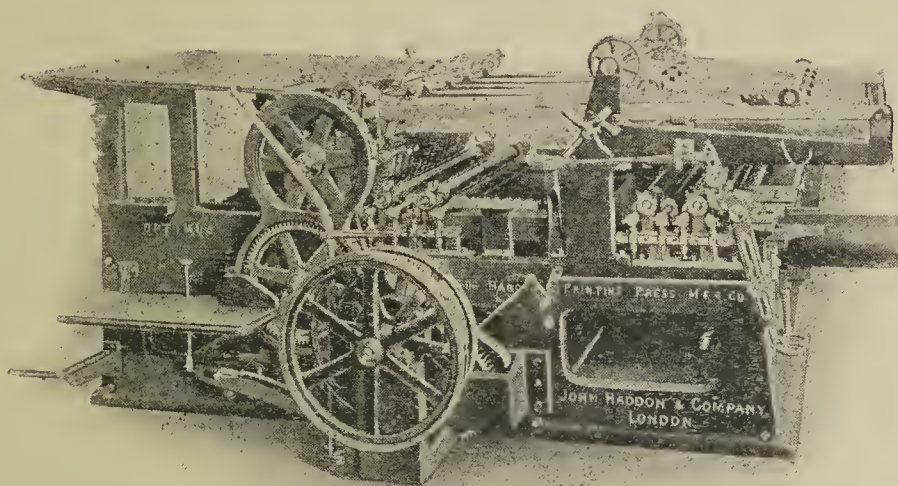


FIG. 26. THE OPTIMUS.

diameter, so that a wearing surface equal to 45 inches of full length track is crowded under the bed along the impression line at each support. The cylinder is carried in solid boxes by means of eccentric journals, the raising of the cylinder being effected by turning the eccentric journals, just as the impression is thrown off and on in a platen machine.

The bed-driving mechanism consists of a flat rack and star gear carried on a deflectible shaft like that already described in connection with the Standard Drum Cylinder Press. The only difference is that this mechanism is heavier and a little more elaborate in the Optimus. The table system of inking used on the Optimus differs from other two-revolution presses in the fact that the fountain is set high above the ink plate and the vibrator puts the colour on the

rider which drives the distributor nearest the fountain instead of direct on to the slab.

Delivery is effected by a system of telescopic tapes which are furnished with automatic tighteners that compensate for atmospheric variations. When the printed sheets are stripped from the cylinder they are carried by these tapes to the delivery end of the press and dropped so lightly on the delivery board that there is always a good cushion of air between them and interleaving is rarely necessary. Three sheets are always on the way, so that ample time is given for drying, and no adjustment of the delivery is necessary, whatever the size of the sheet. Nothing touches the printed surface after it leaves the cylinder, and the sheets are delivered printed side up in full view of the minder.

Messrs. John Haddon & Co. are British agents for the sale of the Babcock Company's machines.

CHAPTER IX.

WORKING THE TWO-REVOLUTION MACHINE.

DETAILED instructions for working two-revolution machines are not perhaps necessary, after what has been said in regard to the Wharfedale machine. The machinist must pay the utmost attention to details, in the matter of machine adjustments, make-ready, and running.

Dressing the Cylinder. If the machine is to be kept running on fine work, the cylinder should be clothed with a permanent covering of stout manilla, or glazed board. To put this covering on, open the grippers, which will be found on the feeding edge under the ordinary grippers, and thoroughly cleanse the edge of the cylinder from all grease. A coat of Brunswick black may also be applied to the edge. When this is dry, take the glazed board or manilla, having previously cut it to the proper size—which should be just wide enough to go inside the beard of the cylinder and about eight or ten inches longer than the circumference of the printing surface—and score (without cutting) a perfectly straight line about one inch from the edge. Carefully fold over this inch of material, and with fish glue stick it on to the previously painted edge of the cylinder. Rub it down thoroughly to secure adhesion, place a nonpareil or long primer reglet against it, and close the grippers. The object of this reglet is to apply pressure to the sheet where the grippers do not touch it; of course the reglet must be removed when the sheet is dry.

The sheet should now be drawn tightly round the cylinder and wound round the first blanket bar or stretcher, and with it made as taut as possible. To make the sheet hug the cylinder still more tightly, it should be damped evenly and quickly all over, allowed to soak and expand for two or three minutes, and then with the stretcher drawn tighter, and allowed to dry slowly. When thoroughly dry there should be no

sign of looseness or bagginess anywhere. To complete the job the packing should be given two coats of shellac varnish, and rubbed with fine sandpaper after each coat, to get rid of any roughness of surface. The varnish is put on to restore the smooth surface which was destroyed by damping, and also to make it impervious to subsequent dampings. Such a packing as this, when properly put on, will last for years, and will well repay the initial trouble. Over this a fine calico or cambric may be stretched, on which to stick up the first sheet. If preferred, the cambric can be dispensed with and the sheet stuck up on to the glazed board direct. This latter method, however, cannot be recommended, as in course of time the packing becomes spoiled.

To stick up the bottom, or foundation sheet, paste and secure the feeding edge first, then dampen and stretch the sheet thoroughly, and finally paste and secure the leaving edge.

While this sheet is drying, the forme can be locked up on the machine. In doing this it must be borne in mind that as the rotation of the cylinder is in the reverse direction to that of the Wharfedale cylinder, the gripper edge must be gauged from the forward end of the bed, and not from the ink slab. Having made the forme secure, and assuming its position is correct, an impression may now be taken, and the making ready proceeded with.

Making Ready. The minder's first step should be, as in the case of other machines, to level up the forme properly from underneath, or in other words by underlays. Having done this he may run a miss. This may be done by placing underneath the forme the full number of sheets, less one, which are necessary to complete the packing of the cylinder, and taking a pull on the cylinder sheet.

The necessary overlays having been made, they should be stuck up on this sheet, and in fact, as far as possible, all defects of impression should be remedied on it before sticking up any more sheets. The overlays should not be placed in perfect register with the impression, but should be stuck a middle or thick lead higher up or nearer the feeding edge of the cylinder. This is to allow for the dragging and tightening of the packing as the work proceeds. Care should be exercised, however, in placing the overlays, to get them parallel

with the work. Use as little paste as possible, and apply it only to the edges of the overlay which are nearest to the grippers.

Three or four sheets, the substance of about 60 or 70-lb. double crown, should now be pasted on the fore edge only and stuck up on to the cylinder, not under the grippers. One dampened sheet, pasted on both edges—one edge being placed under the grippers—should be tightly drawn over the whole, and allowed to dry.

The rollers should next receive attention. These should be so adjusted as just to “kiss” firmly whatever they come in contact with. They should not be set too hard on, or too lightly, as either will cause undue wear, and will knock the rollers to pieces in a very short time. They should be kept well oiled, and run freely in their cups.

The usual American duct will be found to be different from the English one, but properly handled has various advantages. The spring steel blade may prove troublesome if not properly set, by reason of its buckling. To obviate this, begin to tighten always from the centre screw, not from end to end. In re-setting the blade after having taken the duct to pieces, open or withdraw all the screws to their fullest extent, and set the blade a full thick lead away from the ink cylinder. This leaves plenty of room for regulating the supply of ink to advantage. The emission of ink can be regulated, owing to the thinness of this steel blade, at any part of the duct roller to suit the requirements of the work in hand.

CHAPTER X.

AUTOMATIC FEEDERS.

THE day is rapidly approaching when a printer will no more think of buying a printing machine without a feeder attached than he would dream of purchasing one without a taking-off apparatus.

The experimental stage has long been passed, and there are hundreds, we may even say thousands, of feeders in regular operation and doing their work in a thoroughly practical manner.

Among the advantages claimed for mechanical feeders are that they will do the work of feeding quicker, better and cheaper than hand labour ; they are more reliable ; are always ready for work ; and will run night and day continuously with the printing machine.

The main points to be observed in the purchase of a feeder are :—

Simplicity of construction.

Absolute reliability in feeding one sheet at a time.

Separation of sheets with steady regularity.

Able to be changed from one size to another quickly.

Should deal with all the variations of paper as regards weight and thicknesses, and even cards.

Give perfect register.

Be economical in floor space, also in power taken for driving.

Easy to supply with paper.

Reasonable in price.

Should run perfectly at the maximum speed of the printing machine.

Be absolutely automatic with the exception of loading, or supplying with paper.

Should be provided with automatic cut-outs to stop the printing machine or trip the cylinder in case a sheet is not

properly fed up to the front marks, or a torn sheet or part sheet is in the pile and is being fed.

Feeders may be divided into the following classes :

The continuous feeder ;

The pile feeder ;

The double ream feeder.

They may also be divided further into friction and suction feeders, according to the means employed to carry the sheet forward on its journey to the grippers. Further divisions may also be made of those separating the sheets by purely mechanical means or by the use of currents of air.

Space will not allow of a full and detailed description of automatic feeders on the market, but a few notes are given concerning typical apparatus.

The Cross Feeder. This “continuous” feeder, so called because it can be supplied with extra paper whilst running, is illustrated on another page. In general appearance it is totally different to all other feeders, occupying no floor space, but is placed above the ordinary feed board, and may be said to be composed of two feed boards placed at angles, whilst in the apex is placed a drum about 10 inches in diameter.

The operation of the feeder is as follows :—One or two reams of paper are laid on the top feeding board and fanned out the reverse way to which sheets fed in by hand would be fanned out, thus the lowest sheet is nearest the cylinder. The sheets then slowly travel round this cylinder between a set of tapes and a number of metal bands which keep the sheets in their proper place, a second set of tapes on the lower feed board next receives the sheets, along which they travel and come under the action of the “combers” or separating wheels, which separate the top sheet and forces it to travel down to the cut-out tongues (like front marks), the remaining sheets being held back by clamping means. At the proper moment the cut-out tongues rise, and simultaneously a set of drop rolls descend on the sheet and carry it forward down the board, where it comes under the action of a second set of drop rolls which carry the sheet to the front lay marks of the printing cylinder. An automatic side-lay gives accurate side lay.

If the reader carefully notices the fanning out, and the

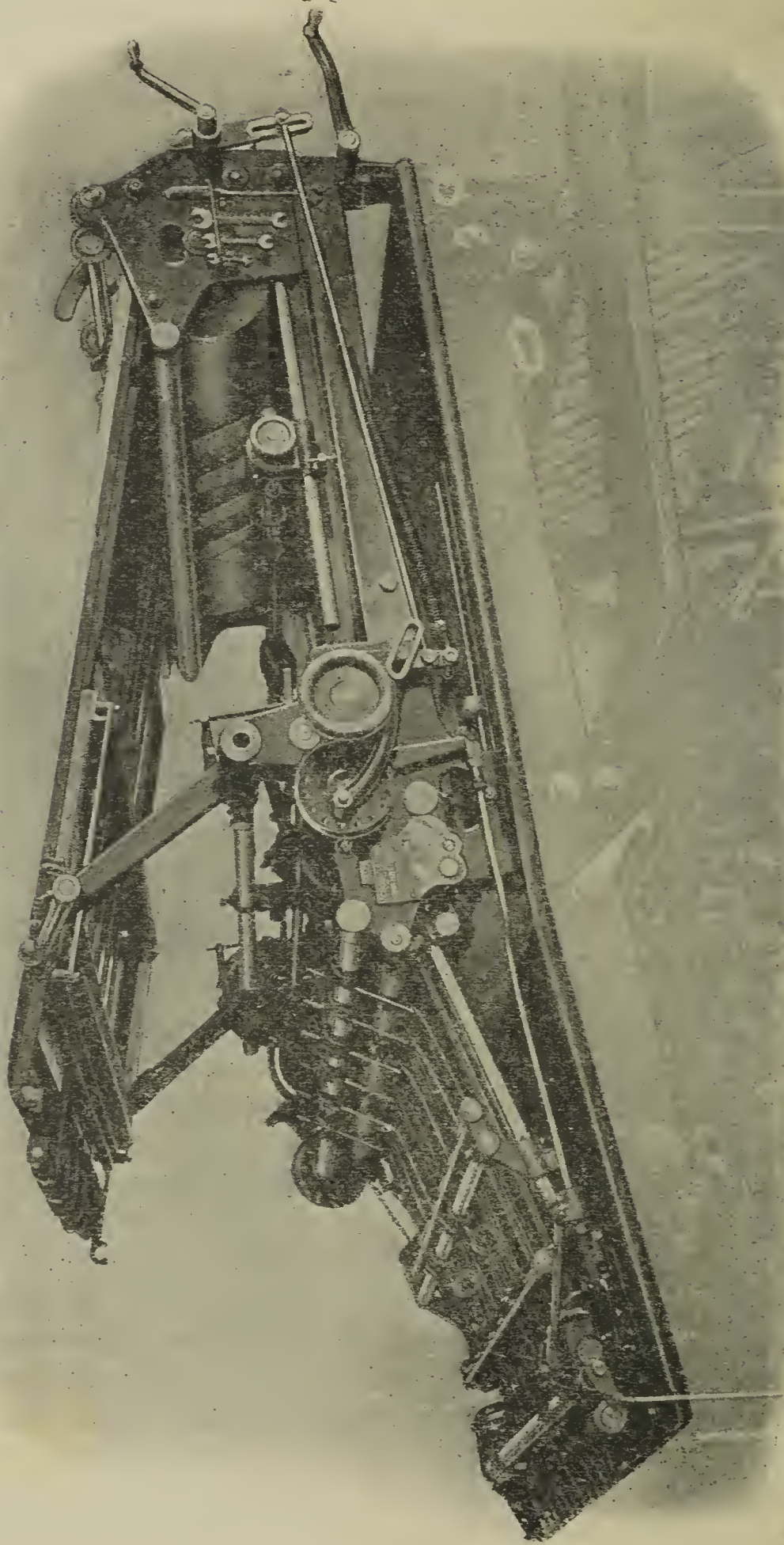


FIG. 27. THE CROSS AUTOMATIC FEEDER.

travel of the sheets round the wooden cylinder, he will understand that the bottom sheet on the top board becomes the top sheet on the lower board and is fed in first.

The Slogger Feeder. This is a friction pile feeder utilising a current of air, produced by blowers, to help in the separating of the sheets, and is illustrated in Fig. 28.

The action in the Slogger is as follows:—After a stack of paper has been carefully placed on the loading board and the feeder started, feelers first descend and hold the top sheets at the front corners; then an oscillating trough or nozzle directs a current of air into the top sheets, loosening a number of them on top of the pile; the nozzle then, by an upward movement, blows the top sheet clear of the others; at this moment the feelers rise and a spring stroker or strokers come simultaneously into action, stroking the free top sheet into the position carrying apparatus, which holds and carries the sheet by means of tapes and wheels until within a short distance of the front lay, when the sheet is caught and steadied by spring catches, which then open and let the sheet travel gently on tapes to the front lays.

An easily adjusted side-lay for the different thicknesses of paper, and of the push and pull variety, now comes into operation, securing a perfect side lay, and, when effected, spring holders grip the sheet and hold it until it is taken by the cylinder grippers.

The Vickery Feeder. This is a suction feeder also using a current of air to help to separate the sheets. An oscillating nozzle or nozzles descend on the top sheet, lifts it and carries it forward into the tapes.

The Dux Feeder. This is a friction feeder of simple action and construction which operates very similarly to hand feeding. A fanning or stroking-out wheel on the end of an arm or arms acts upon the sheets, fanning them out so that the top sheet is always a little in front of the one underneath. This wheel is balanced by an easily adjusted counterweight, to give the wheel more or less pressure according to the nature of the paper used. The wheel can be thrown up by raising the arm if free access to the paper is required. On this arm are placed adjustable feet, which can be moved to and fro according to the size of the sheet being fed in, the action of these

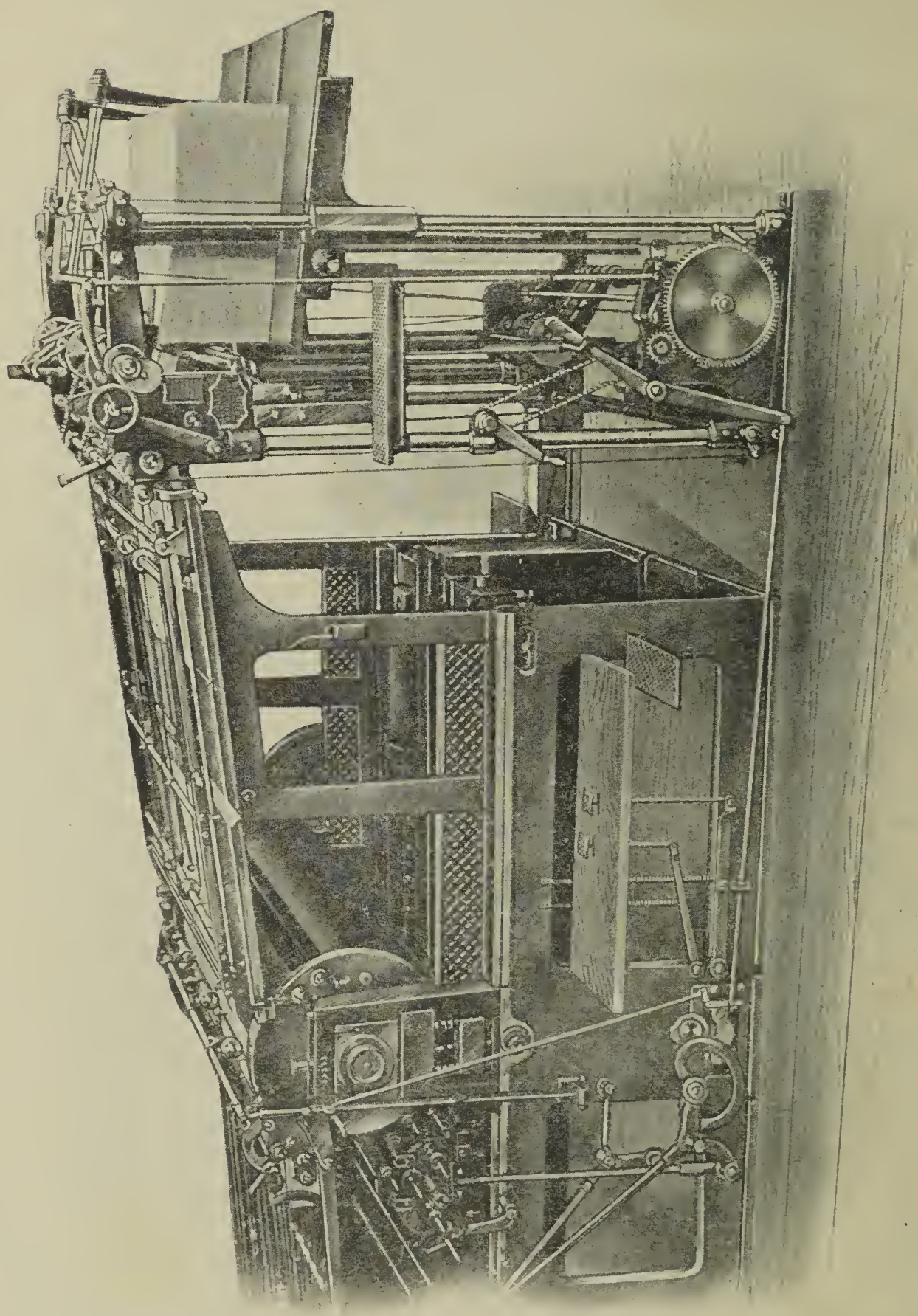
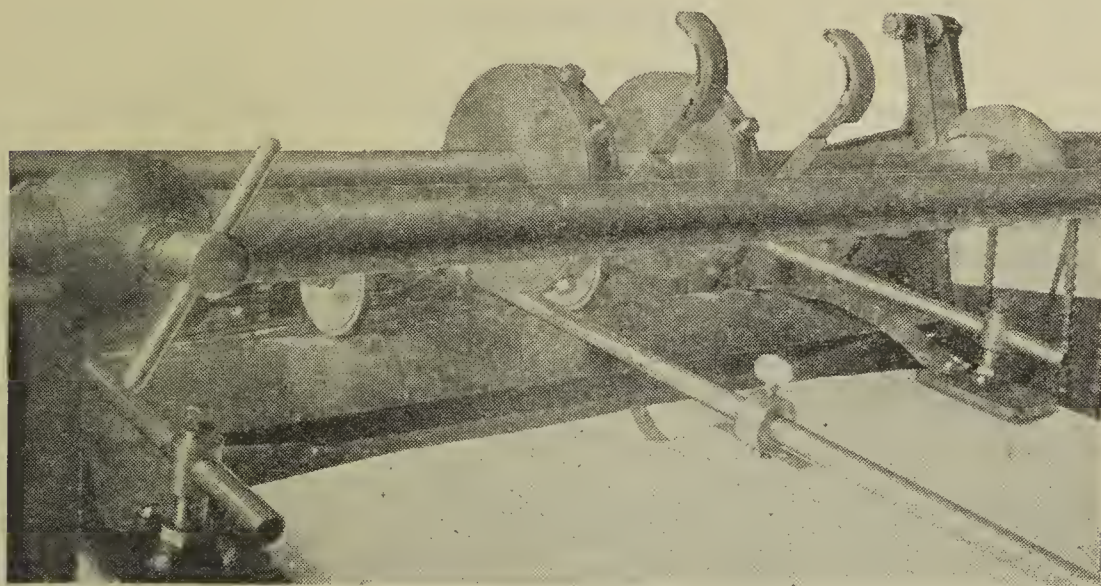
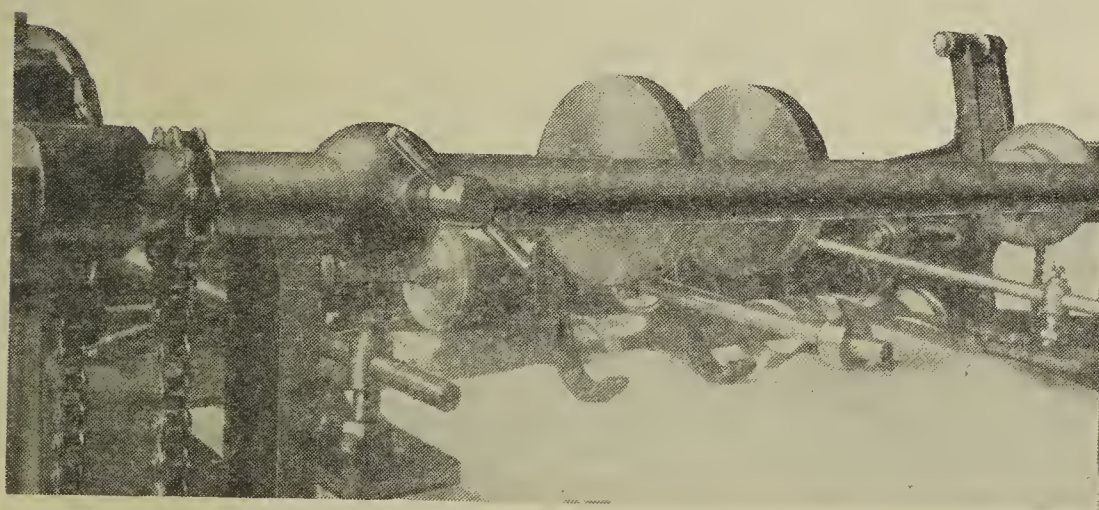


FIG. 28, THE SLOGGER AUTOMATIC FEEDER.

feet being to come down on the second sheet and hold it and all underneath, while the first or top sheet is fanned out and taken down to the front marks. The fanning wheel is slightly



A. Sheets being separated by air-blast and stroking fingers on the point of descending on sheet.



B. Stroker fingers in operation and carrying sheet to receiving bosses ; from which moment the sheet is under complete control until printed.

raised when the brake, i.e., the action of the feet, is on ; the lifting of the wheel and the pulling down of the feet are simultaneous.

The side lay is an automatic push-and-pull action.

There are a large number of other feeders on the market including the Koenig, Dexter, Fischer, Universal, Chambers, etc., also feeders for platen machines.

CHAPTER XI.

TWO-COLOUR AND TWO-FEEDER MACHINES.

Two-Colour Printing Machines. When much work in colours is done, such as showcards, posters, etc., two-colour machines are sometimes employed. They are designed on the same general principles as the ordinary Wharfedale, but have an inkslab and inking arrangements at each end for the two colours. The cylinder revolves twice for each impression. The carriage is double, having space in the centre for two formes. The formes are inked up by passing under the inking roller, and the cylinder (with the sheet of paper to be printed) rolls over both formes before it stops. A two-colour impression is thus obtained on it at each travel of the carriage. The sheets are fed in and delivered as in the single-colour machine. If more than two colours are required in the job, the formes for them can be worked successively. These machines can be used as single-colour machines, but at a slower speed, owing to the length of the traverse of the carriage.

Except for very long runs the advantages of two-colour machines are doubtful. The work is done almost as quickly and more conveniently by dissecting the forme and printing the different colours successively, by the method to be described hereafter under the heading "Colour Printing."

Multi-Colour Machines. A large number of inventions have been patented which have for their object the printing at one operation—that is during one travel of the table and between the feeding and the delivery of a single sheet—a number of colours. These inventions have not as yet been brought much further than the experimental stage.

Two-Feeder Machines. For newspapers with a circulation requiring a faster machine than those previously mentioned, and yet not so large as to warrant the expense of web machines, two-feeder machines are built. They have only

one cylinder, but the feeding is done from both ends by two layers on. Only one side of the paper is printed at once, at a speed of about 1,500 per hour for each feeding board.

The best machines of this kind are made to print formes of various sizes, without any alteration of the printing surface of the cylinder, removal of blankets or tapes. The sheets should be fed direct into the grippers, and delivered by flyers in the usual way. In most two-feeder machines the travel of the type bed is considerable, but in modern machines this is reduced to the minimum for small sheets, thus increasing the speed of the machine.

The Two-Feeder Perceler made by William Dawson & Sons, Otley, is of the Wharfedale type, practically designed for magazine and kindred illustrated work. It is constructed to work at the rate of 2,500 copies per hour, or 1,250 from each board (from one forme) of a quad demy size, in perfect register. The machine is provided with two feed-boards inclining to the centre, from which the cylinder, provided with grippers, receives the sheets, first from one board and then from the other, the sheets being delivered at the end opposite to which they are fed, under the feed board, printed side up without anything coming into contact with the printed matter. There is plenty of roller power, four large rollers covering a full sized forme at each end of the cylinder, each set being provided with two reciprocating riders, one connecting rider, and two storage rollers, as well as geared distributors and steel knife to ink duct. A feed-check is provided for each board. By checking one feed the machine is at once converted into a single-feed machine.

The latest Bremner Two-Colour Machine embodies all the advantages that the combined experience and skill of printer and engineer can suggest. It is built on the well-known Victoria framing, which is artistic in appearance, and yet gives the maximum amount of weight and strength. The frame sides are made in two parts which are braced together with five massive cross rails, the centre cross rail being in a direct line under the impression cylinder.

In the new delivery the sheets are delivered printed side up at a convenient height and angle. The delivery cylinder

can be instantly raised 10 inches clear of impression cylinder leaving ample room for make-ready.

Three sheets are in transit at the same time, and each sheet is brought to a standstill for two or three seconds to receive a current of warm air which helps it to dry before being delivered.

Another important feature is that the machine delivers manifold with the same ease as art paper.

The delivery is at the feed end of machine, thus leaving the other end entirely open, giving the operator full access to both formes.

The geared inkers are a compact arrangement of four $3\frac{1}{2}$ -inch inkers covering a full size forme, with three steel riders and two 3-inch composition riders.

CHAPTER XII.

PERFECTING MACHINES—MECHANICAL FEATURES.

THIS term is applied to machines which print single sheets of paper on both sides during their traverse from the feed board to the delivery board. Rotary web machines also perfect the paper (in the web instead of in single sheets) before it is delivered, but they are not usually, except in the United States, termed perfecting machines. The best known and most largely used are of the former class.

This class of machine is practically dying out, with the exception of one species of make—the Huber, for instance. The reasons being the constant shortening of time allowed the printer, in the case of weekly papers, between the passing for press and the publication hour ; the increased circulation ; also the introduction of half-tone illustrations, and the demand for a much higher grade of work.

The first two cases call for the use of rotaries, and the last the use of up-to-date two-revolution machines, or, in the case of large runs, art rotaries.

Long runs of book and pamphlet work are at the present time machined on all-size rotaries.

The perfecting of the sheet in a short space of time greatly limits the scope of the machine on account of set-off troubles, the second impression coming almost at once on that made by the first cylinder, and the trouble of keeping the colour even on both sides of the sheet. The limited rolling power in the large cylinder type is another drawback.

Perfecting machines that are and have been on the market may be divided into two classes :—

The Cowper type, with two large cylinders and small intermediate cylinder or cylinders, the sheets in the majority being carried through by two sets of tapes ; and the

Napier or Frenchman type, with smaller printing cylinders,

the sheets being taken direct from the grippers of the first printing cylinder by those of the second.

The first class includes those made by Dryden & Foord, Middleton's, Benson & Adams, Foster & Sons, Dawson & Sons, and with modifications Payne & Sons, whose machine has a low feed board, the large cylinders close together, the smaller cylinders on top, the sheet being held by grippers on both printing cylinders, then taken off by flyers on to a high board.

Dawson & Sons' Gripper has large printing cylinders with one intermediate cylinder, and can be used as a perfecter, altered to a two-feeder, or two single-cylinder Wharfedales, so that two formes of different sizes, if necessary, can be worked off at the same time.

The second class includes those made by Newsum, Davis, Payne & Sons, Marinoni, Blauzet, Hoe, Scott; the Miehle, Cottrell, and the Huber-Hodgman, etc.

Marinoni's could also be used as a duplex single-cylinder. They now build a much improved machine, which can be adapted to print from a reel as well as by hand, any size sheet cut off, with a continuous set-off similar to rotaries.

The Kelly Perfecter was noted for large and small cylinder. Dryden & Foord also invented a Wharfedale single-cylinder perfecting machine, the cylinder having two sets of grippers, each acting distinctly apart from the other. The sheet is taken by one set of grippers and one side printed, it then travels up a board placed at an angle higher than, and beside the printing cylinder, until it is stopped by a back mark; it is then automatically laid to register, the second set of grippers take it by the tail and finally the sheet is perfected on the second half of the cylinder.

The Middleton machine has, as its main features, two large impression cylinders which print the inner forme and then the outer forme respectively. The sheet is conveyed by tapes round the first of these, then over and under two smaller cylinders or "drums" called the reversing cylinders, and presents the white side to the forme and is printed by the outer forme cylinder. The following diagram will show the general arrangement.

The impression cylinders A and B are placed on strong

supports above the side frames, which are low, being about $2\frac{1}{2}$ feet high. These cylinders are at about equal distances from each end of the machine. The laying-on board F is above the inner forme cylinder, and the sheets are fed in from it by a man standing on a stool or short ladder. There are two formes, and two sets of inking rollers, each nearly

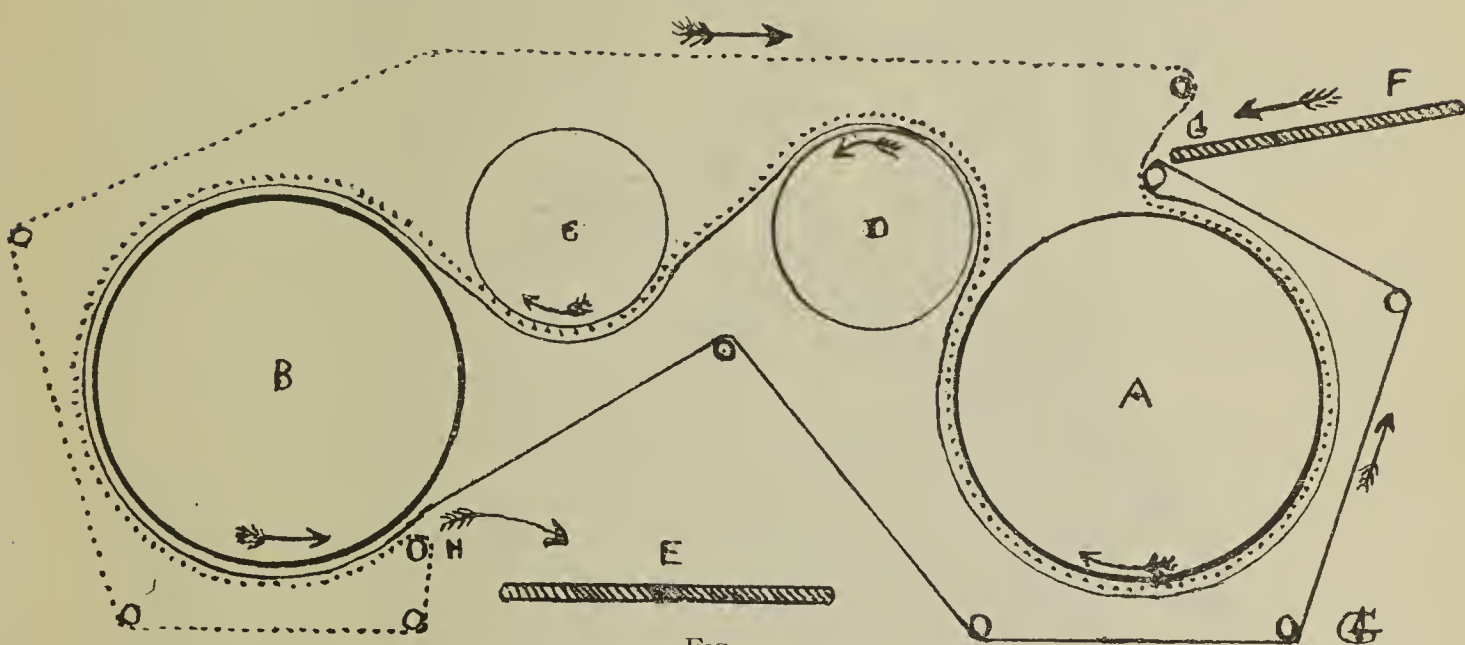


FIG. 29.

- | | | |
|-------------------------|---------------------------------|----------------------------|
| A Inner-forme cylinder. | C, D Reversing drums. | F Laying-on board. |
| B Outer-forme cylinder. | E Taking-off board. | G Entry of sheet to tapes. |
| | H Delivery of sheet from tapes. | |

The plain and dotted lines show arrangement of tapes, and the arrows the travel of the sheet and direction in which reversing drums, cylinders, and tapes are moving.

underneath one of the cylinders. At each end of the machine there are a duct and distributing rollers.

The *printing cylinders* have each a circumference about equal to the length of the two type beds. This admits of the forme returning the reverse way of the travel of the cylinder between every impression. Only about half of the surface is used for the impression. Each cylinder revolves continuously, hence it is of two different thicknesses—that portion which effects the impression of the type being thicker than the remaining part. When the forme returns, it passes beneath this thinner portion of the cylinder without coming into contact with it. Attached to the inside of the thinner portion is a counterweight, to balance the action of the cylinder and make it run regularly. Both cylinders are driven direct from the main shaft in the middle of the machine, on

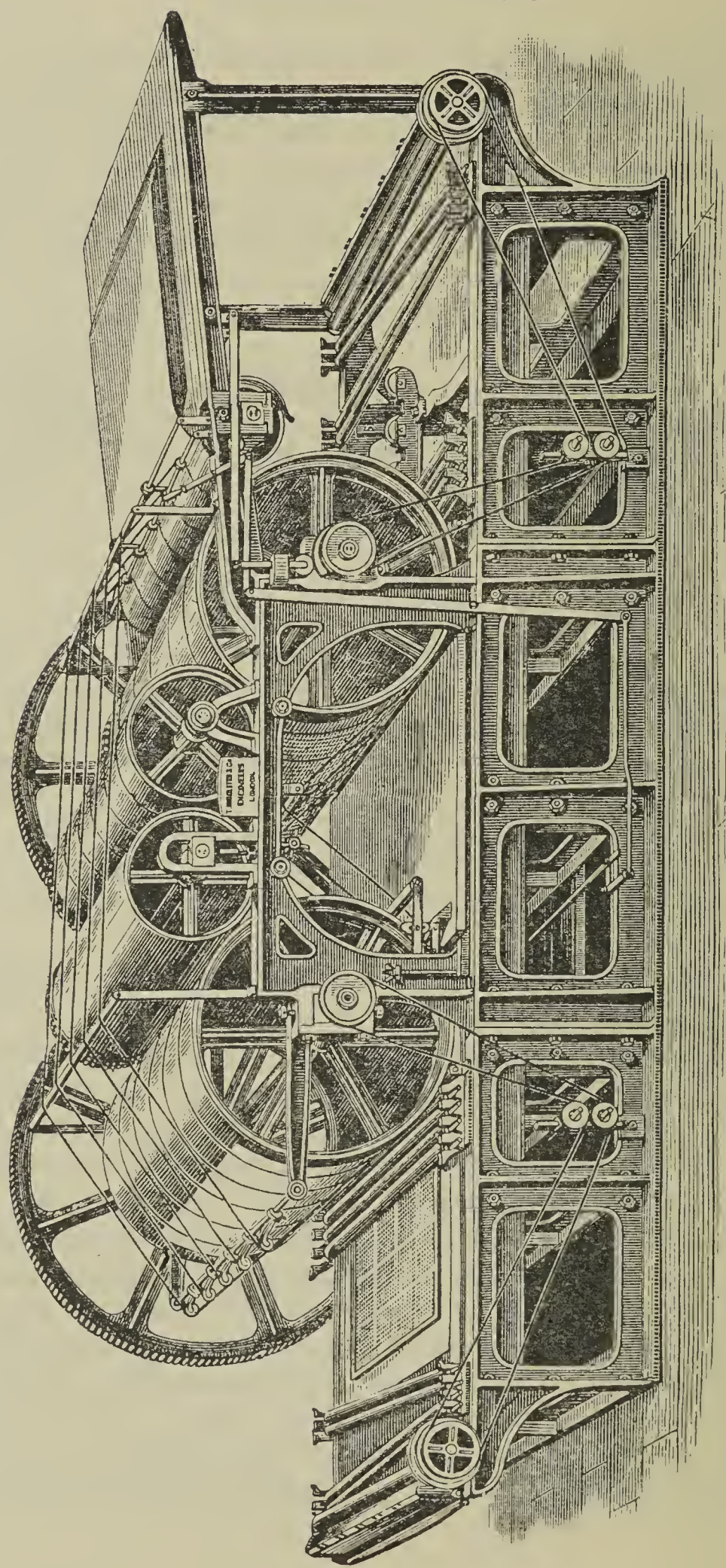


FIG. 30. THE MIDDLETON MACHINE.

the off side, upon which is fixed a pinion working in gear with a large cogwheel at one end of the inner forme cylinder. This latter works in gear with a similar wheel on the outer forme cylinder. The effect of this is to cause each cylinder to have a contrary motion.

Between and slightly above the impression cylinders are two wooden cylinders, C and D. These have always been called the reversing drums, but are not necessary for reversing the sheets, as it will be noticed by reference to Fig. 29 that the sheet is travelling exactly from the second of these cylinders as it does from the first printing cylinder. The drum C is the "register drum." It can be raised or lowered on either side by screws. This enables the impression of the two formes to be registered, by making the travel of the sheet longer or shorter.

The sheet is secured during its progress while printing by tapes. There are two sets of these, arranged as shown in the accompanying diagram. Those indicated by the dotted line are called the inner forme tapes, and those shown by the plain line the outer forme tapes. There must be as many of these endless bands as there are gutters in the formes between which they run, in order that the sheet may be kept smooth and tight round the cylinders. The sheet after receiving the impression from the inner forme is conducted over the first reversing drum D, and under the second C, to the outer forme cylinder B, and thence to the taking-off board E. The taker-off sits on a stool adjacent. The reversing drums receive their motion from a cogwheel inside the inner forme cylinder wheel.

Movement of the Tables. The two type beds and ink tables are fixed to planed "table" bars, the under sides of which travel over a series of substantial pulleys, fitted to parallel girders, running the entire length of the machine. Immediately under each of the impression cylinders are two large pulleys, affording extra strength at these points and ensuring a solid resistance. The tables are moved to and fro by an ingenious arrangement known as the "rack and parallel motion." There is an upright spindle and a rack driven by a bevel wheel fixed at the end of the driving shaft. The rack is placed horizontally under the table with the cogs downwards. The rack as it were travels round the spindle, as the

latter is stationary. When the end is reached the rack moves rapidly to the other side of the spindle by means of a circular end, reversing its motion again when the other end has been attained. In order that the whole of the rack may move from one side of the machine to the other at the same time when the pinion wheel traverses round the end, and to keep it exactly in position, two long bars are provided, having a short arm attached to the opposite end of each bar. Two ends are bolted under the type beds and the other ends of the bars are fixed to the rack. Across the centre these bars are joined in order that they may work uniformly. A broad groove is made in the centre of the rack large enough to allow this crossbar to work freely. The correct working of the rack depends upon this parallel motion, which if ineffective would have a tendency to move the rack to the other side of the machine in an irregular manner.

The inking arrangements are slightly different to single cylinder machines. The ink cylinders, or ductors, at each end are driven by gut bands working in graduated grooved wheels, by which the supply of ink can be regulated. The bands run over similar wheels on the shaft of each impression cylinder. If a greater supply of ink is needed, the band is placed round the larger groove on the cylinder shaft, and the smaller one on the ductor; and if a lesser, *vice versâ*. The rolling on this machine is not entirely satisfactory, as all the rollers do not clear a full-size forme. The distributing arrangements consist of four wavers, working at angles.

Set-off. To prevent set-off, which a machine of this kind is very liable to cause, bands of paper, of the required width and length, can be placed over and under the outer forme cylinder. The bands are pasted together forming a kind of endless revolving belt, intervening between the printed side of the sheet and the impression cylinder. The length of this endless piece of paper being greater than the circumference of the cylinder, a different portion presents itself to the impression every time. The liquid set-off apparatus can be fixed to the second cylinder, above the taking-off board.

Feeding Arrangement. Three different plans have been adopted for carrying the sheet into the tapes.

The web system consists in feeding in the paper by means

of a web, or series of wide tapes, which lie upon the laying-in board. A small drum stands directly under the board and to it the tapes are fastened. On the off-side of the spindle is a series of cogs, resembling a sector, with a long wooden arm fastened to the under side. A stud is fixed on the cylinder wheel of the inner forme, and when it comes into a certain position the stud glides on the surface of the arm, thus bringing the cogs on the drum into gear with a similar set on the cylinder wheel. By this motion the drum rotates a part of its circumference, and moves the web, or tapes, in the same direction. The sheet having been laid to a back mark on the tapes, is propelled between two revolving rollers, and is thus taken into the machine. This plan is almost obsolete. It is impossible to feed in more than a thousand per hour, and the work of laying-in is tedious and dangerous.

The second method of feeding is the drop-bar action. The drop-bar consists of a bar fitted with several movable metal discs or bosses about half an inch thicker than the bar itself. These can be moved by means of screws to any position along the rod, so as to adapt them to the size of the sheet to be printed. When the sheet has been stroked down to the front lay marks on the feed board, the bar is depressed by means of a cam and descends upon the paper, pressing it against the disc, the squeeze causing it to be conveyed to the tapes at the proper moment, and on to the inner forme cylinder. This method is preferable to the preceding one on account of the greater speed of feeding that is attainable.

The third system is the gripper arrangement. Inside the gripper drum, which revolves twice between every impression, is a bar to which the grippers are secured. After the paper has been stroked down to the front marks, the closing of the grippers on the sheet is effected by means of two small cogwheels fixed within the side frame of the machine. These wheels work in each other, a shape being attached to the upper one, which, at every other revolution, strikes a pin attached to the gripper bar, and so causes the grippers to close. When the grippers are down, a pin fixed on the frame of the machine strikes the stud on the gripper bar, and releases the sheet into the tapes. This stud, when the grippers are open, clears the pin on the frame during one revolution of

the drum. The gripper system is preferred to the others for the accuracy of lay it admits. In the drop-bar the sheet is liable to be taken in a trifle before or behind the lay of the previous sheet; but with the gripper the grip is given unerringly and uniformly to each sheet.

The second class of perfecters (the Napier or Frenchman class, named, the one after the inventor, the other from the country) have certain distinct principles from the Cowper class, viz., two small cylinders working together, the whole of the surface, as in a Wharfedale, being used for the impression; the sheet is taken by the grippers of the first cylinder from the laying-on board, then by grippers on the second cylinder direct from those of the first, both cylinders being alternately raised to allow the forme to pass under when not printing.

This class of machine can best be described as the placing back to back of the major part of (i.e., cylinder to ink duct) two modern two-revolution cylinders (see diagram below).

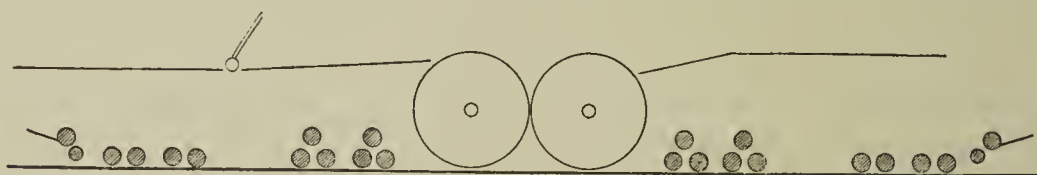


Diagram showing principle of operation of a two-revolution perfecting machine.

The use of smaller impression cylinders enables inking arrangements equal to the modern two-revolution press to be used, thus enabling a better class of work to be produced.

The set-off arrangements of this class of machine generally consist of a reel of set-off paper inside the impression cylinder, from which it passes through an opening in the cylinder and around the impression surface, when it passes through an opening into the impression cylinder again and is rewound. Mechanism is generally arranged to alter the rate of shifting as the nature of the work requires, giving a complete new surface varying from ten up to 150 impressions.

The raising and falling of the cylinders are generally effected by cam and lever movements combined with strong springs, as in the two-revolution press; in others by knuckle joints. This obviates cutting away part of the cylinder and enables the whole surface to be used.

The laying-on board is over one end, the feeding being on top of the cylinder, while the taking-off apparatus at the other end of machine consists of drum, tapes and fan, as in the ordinary Wharfedale.

Practically all bed-driving arrangements of the one-side machine can be used, and every make varies in the means employed. The main points to be observed, owing to the great weight, being double of the one-sided machine, are that the arrangements are powerful enough, at the same time allowing for the extra supports needed, which should consist of at least four sets of rails, with solid supports under the impression cylinders. Buffers or other arrangements should be made to help the stopping and return of the bed at each end.

To take a specific instance of a standard machine, *The Hoe Perfecting Press* is constructed upon the principle of their two-revolution machine. It is built very strongly indeed throughout, and braced underneath each impression cylinder for a very powerful impression.

The bed carries, of course, two formes, each of which is inked by four rollers, all clearing the forme. The sheet is fed to a feeding cylinder, which conveys it to the first impression cylinder. After being printed on one side, the sheet is transferred to the second impression cylinder, which prints the reverse side, and the perfected sheet is then delivered by the fly in front of the machine. The second cylinder is provided with a shifting tympan, to prevent set-off.

The cylinders are driven independently of each other, and each has a long segment that gears into a rack on the bed during the entire impression, for the purpose of register. Whilst the sheet is being transferred from the first to the second cylinder, the cylinders are geared by means of segments to ensure accuracy of transfer.

There is a trip for running up the ink and for tripping the cylinders while the press is running. This is arranged so that both cylinders are tripped—first the first cylinder, and then the second one at the proper time, the object being to prevent an impression by either one when a sheet is missed, without interfering with the completion of the preceding sheet.

The fly frame and feed board are so arranged that they can

be easily and quickly raised, leaving the formes and cylinders entirely clear, and either cylinder can be tripped at will by means of a hand trip while making ready.

The machine is furnished with a reversing motion and air springs, there being two air cylinders at each end of the machine, one at each side.

CHAPTER XIII.

WORKING AN ORDINARY PERFECTING MACHINE.

THE following instructions apply to the working of the Middleton Perfecting Machine. Several of the newer types are much less complicated—so much so, that anyone acquainted with the working of an ordinary single cylinder machine can in a very short time understand their action. It is not necessary, therefore, to give detailed directions for running them.

The machine minder first of all stretches a piece of calico over each of the impression cylinders, which becomes the foundation for the packing. The ends of the calico are sewn to the iron bars provided for the purpose. Over the calico are placed half a dozen sheets of paper. Over these the blanket is stretched and secured by pins. The machine has now to be taped.

For the inner forme cylinder the method is as follows. The reel of tape is put round the cylinder, *over* the first drum, *under* the second, and lastly *over* the outer cylinder. Stretch it *round* the roller immediately in front of the taking-off board, and down *under* a similar roller beneath. Carry it parallel under the cylinder, outside the roller, and thence over the tightening pulleys and above the dropbar or the gripper drum, sewing the ends together.

The next tape may be pinned to this first one at the outer forme end and the machine allowed to run very slowly until the end of the tape reappears. Cut this off from the reel and sew as before. The tape can easily be shifted in position by slightly pulling one point forward, making it a fixed point as it were, and running the machine slowly. All the other tapes for the inner forme are put on in the same way.

For the outer forme start from the tightening pulley over the outer forme table. Carry the tape over the roller above the register drum and over the roller above the gripper on

the dropbar drum. Continue round the latter and the inner forme cylinder—over and above the first and register drum respectively. Take it thence over the outer forme cylinder, above the delivery roller, and down under the bar that is immediately below. Then carry it horizontally to the companion roller near the base of the cylinder, and join up at the point of commencement. The remainder of this second series of tapes may be run in the same manner as for the first series, by attaching an end to the one already in position and running the machine slowly until the end reappears.

Round the iron rollers, under the two impression cylinders, guides are fixed which prevent the tapes wandering. The tapes must be so guided as to travel one set exactly on the top of another.

The tapes must next be set in position so as to come immediately in the centre of the gutters of the forme. This is done by laying a sheet on the outer forme and fastening the latter, when the proper position of the tapes can be determined. The inner forme may be put on the other bed. The forme should be placed in position by arranging the pitch with a gauge kept for the purpose. Next the impression is adjusted by regulating the cylinder. If there is too much pressure the cylinder is raised by loosening the top impression screw and tightening the lower. If there is not sufficient pressure the process is reversed. The impression screws should not, however, be altered unless it is absolutely necessary to do so. A proof is pulled and the underlaying done for both formes.

The register should be regulated by altering position of the outer forme, if possible, as it is the easiest of access.

The operations involved in preparing the machine for working a forme may be thus enumerated :—

1. Putting on the calico.
2. Pinning the blanket.
3. Putting on the tapes.
4. Setting the tapes.
5. Adjusting the impression.
6. Putting on the underlays.
7. Packing the cylinder bearers.
8. Trimming the vibrators, wavers, and inkers.

9. Filling the duct and arranging the metal stops.
10. Regulating the supply of ink.
11. Adjusting the register.
12. Patching the overlays.
13. Running up colour.
14. Placing the set-off in position.
15. Working off.

Before beginning to make ready on a perfecting machine the following points should be attended to :—

1. See that the tapes fall between the heads, backs, or gutters, and not over the type.
2. That the tapes are sufficiently tight to keep in their proper position.
3. That the register is correct.
4. At a gripper machine that the pitch is correct, or the forme may get damaged. The safest way of getting this correct pitch is to keep a gauge of the exact space required to be left between the ink table and the type.

Some machine minders do not follow this method in the order given, but it is that adopted in many of the largest metropolitan offices.

In perfecting a book forme, such as a sheet of stereo plates, on a perfecting machine, the most important parts to attend to before making ready are :—

1. To see that the tapes fall between the heads, backs, or gutters, and not over the type.
2. That the tapes are sufficiently tight to keep them in their proper position.
3. That the register is correct.
4. If the machine is a gripper machine, care must be taken to get the correct pitch before pulling an impression, or the plates may be damaged. The safest way is to keep a gauge of the space required to be left between the ink table and the type.

Certain points must be carefully watched on this kind of machine while running, in order that good work may be obtained. Amongst these points are :—

1. That the tapes do not break or become loose and slip on to the forme.

2. That the supply of ink is kept even, and the edges of pages do not get more ink on them than is necessary.

3. That the ductor bands do not come off.

4. That the rollers do not skid or jump and imperfectly roll the forme.

5. That the set-off paper does not become torn or black, thus soiling the work.

6. That the sheets continue to register accurately.

7. That no slurring occurs.

8. That the furniture round the plates does not ride, and thereby black the margins.

The making ready on the Napier class is practically the same as with the one-sided machine. The following points must, however, be specially noted :—Accurate register must first be obtained before any patching up is done. Care must also be taken that the grippers on the second cylinder do not come into contact with those of the first, also that the timing is perfect.

CHAPTER XIV.

ROTARY WEB PRINTING MACHINES.

A CHARACTERISTIC of all the machines so far referred to is that the printing surfaces are flat. Two kinds of impressing surfaces have, however, been noticed. In platen machines it is a flat plate ; in cylinder machines it is a revolving cylinder. Another class of machine has now to be dealt with—the rotary machine, in which the printing surfaces as well as the impressing surfaces are revolving cylinders.

In the diagram annexed (*a*) is the cylinder which gives the impression, sometimes called the blanket cylinder, as it is packed with blanketing like the cylinder of a flat-bed machine ; and (*b*) is the printing surface, or stereo cylinder—the paper being carried through between the two cylinders. The arrows indicate the direction in which the pressure is applied.



FIG. 31.

As movable type cannot be safely, or at least satisfactorily, fastened to a cylindrical bed, stereotyping has to be resorted to, curved plates being cast from the formes and mounted on the periphery of a cylinder.

Rotary printing can be done at an enormously increased speed as compared with flat-bed printing.

Machinery of this description prints, instead of single-cut sheets, webs, rolls, or reels of paper, as they are variously denominated, usually about 3 to 5 miles in length, according to their thickness. Whereas hand feeding of large single sheets can be seldom done with safety at more than about 30 or 32 per minute, 1,800 per hour for each layer-on, the web can be run through a rotary machine at almost any speed. It is wound up tight and as hard as the trunk of a tree; its weight ranges from 3-cwts. to a ton, according to its width. If it is ordinarily well wound it will be nearly as true and round as if it had been turned in a lathe.

The greatly increased speed of a web machine as compared with a single-sheet flat-bed machine arises from two causes:—

1. Its operations are all continuous; the forme cylinder and the impression cylinder always turn in one way.

2. The feeding is from a roll of paper which is unwound as rapidly as required.

In a web machine as soon as one newspaper is printed the next one is begun. The impression cylinder is always small—about 60-in. in circumference, or about 20-in. diameter. Small cylinders turn more rapidly than large ones; have less weight of metal; require less strength in their axle and axle bearings, and obstruct the light less than others.

It is not practicable to secure types on such small cylinders; hence the invention of the method of casting curved plates by the paper stereotype method was as essential a preliminary to success as that of the paper making machine.

The cylinders of web machines may be lengthened, so that two newspapers may be printed side by side, simultaneously. The same roll of paper will answer for both if its width is doubled. Such machines are called double-width web machines. All that is required is a double set of plates.

Another advantage of these machines is that they may be supplied with a folding arrangement. The paper does not slip, as a single sheet is liable to slip. Hence the folding may be done as fast as the press can print. The sheets can be pasted together at the back by a brush or narrow wheel.

Inking is very simple, for the rollers are placed against the surface of the forme cylinder, which as it turns round is inked.

Perfecting, or printing of both sides, is equally simple.

The paper is printed on one side in passing between the forme cylinder and the impression cylinder. The process is then repeated for the second side by passing the paper between other cylinders.

Cutting is now done after printing ; but on some early web presses the paper was cut before it was printed.

Counting can be done automatically. The sheets are piled up for a moment in one place, and then piled up in another, so as to permit of piles consisting of quires, for instance, being removed by the attendants.

Accuracy of register is easily attainable, as the roll of paper runs more steadily through the machine than single sheets.

Colour work is being successfully done on web machines. The principle is to have additional printing cylinders, with red, green, blue, etc., ink ducts near to them. When a picture is to be printed in two colours, for instance, a part of one of the stereo plates is cut out so as to leave a white space in the impression. The stereotype plate for the other colour is adjusted so that it will strike exactly where this blank is left. The process is repeated for as many colours as are required. In this way newspapers of large circulation can be printed in several colours at high speeds, or may contain coloured pictures.

The output of combination or multiple web machines is almost unlimited. Already machines are built, as will be mentioned hereafter, which produce large papers at the rate of 96,000 per hour.

It was formerly the practice to put the roll of paper through a damping machine in order to render it more fit for printing. Dry printing, however, is now common, paper makers having been able to produce paper that can be printed dry.

General points of advantage in Web Machines. The following features should be looked for when considering the installation of rotary presses. They are not arranged in order of importance :—

1. Speed.
2. Simplicity, certainty and reliability of action.
3. Accessibility of every part from the floor on which the machine stands.
4. Compactness, giving economy of floor space.

5. Rigidity and freedom from vibration when running at high speed.
6. Superiority of materials and of workmanship employed.
7. Efficiency of ink distribution.
8. Economy in working.
9. Efficiency of the counting device.
10. Efficiency of the folding arrangements. They should give the "natural" fold, and fold down to half or quarter-page size. Each 4-page sheet should be cut from the web, 2 being pasted together at the middle margin if it is desired to make 8 pages. The first fold should be into page size, the second across the page into half-page size. This is the most usual form in which papers are delivered, although sometimes an additional fold is given, reducing them to quarter-page size.
11. Avoidance as far as possible of tapes, which are liable to cause blocks to smear the sheet, etc., besides causing loss of time in re-stitching them.
12. Facility for variation of size of pages from one number of columns to another, and in the number of pages.

During the last few years great changes have taken place in the production of newspapers. They have enormously increased in size, for instance. Cheap paper and mechanical composition have contributed to this result, and printers' engineers have been prompt in providing efficient and reliable fast rotary web printing machines capable of producing newspapers varying from four to sixteen pages at one operation.

Although merely historical matter would be out of place in a practical work like the present, it is necessary, in order to point out the distinctive characteristics of modern fast printing machines, to review briefly the successive steps by which they have been brought to their present condition of efficiency.

The Simple Rotary Printing Machine. For a considerable number of years unsuccessful efforts were made to print from a web or roll of paper. For the last hundred years paper has been made in the roll, by machines, instead of in hand moulds which produced only one sheet at one operation. Hence there was no difficulty in obtaining paper in this form, and it would seem to be a simple problem to draw a roll of paper into a machine, to print it, to cut it into sheets, and to deliver them.

Insuperable difficulties long prevailed, and, although made in the reel, the roll was cut up into sheets of specified sizes and in that shape the paper was delivered to the printing office. Amongst the earlier inventors who contributed largely to the evolution of the web printing machine was the late Mr. T. Nelson, the founder of the great Edinburgh firm of printers and publishers, Messrs. T. Nelson & Sons. Mr. Nelson made a working model in metal, the scale being about one-quarter the full size of a web printing machine, which was really a marvel of design and construction. This machine was exhibited in the Great Exhibition of 1851. It does not appear to have attracted general attention, but evidently engineers engaged in the perfecting of such a machine paid careful attention to its design and form of construction. Mr. Nelson did not patent his invention, which was evidently a little before its time, as it was not until fifteen years afterwards that a practical machine, fit to print a newspaper, was built. Mr. Nelson's machine was arranged with all the printing cylinders one above another in a vertical stack, and this was exactly the way in which the original Walter press was constructed.

Where Mr. Nelson's invention failed was in his endeavouring to make the second stereo and blanket cylinders cut the web into sheets instead of employing separate cutting cylinders for that purpose alone, a method adopted in all modern web printing machines. Mr. Nelson's machine is now in the South Kensington Museum, where it forms a very instructive lesson in the progress of modern printing.

Rotary web printing in England was first rendered practicable by engineers employed in the office of *The Times*, who produced the Walter Press, which was completed in 1866. There was a continuous roll of paper wound upon a spindle, and this paper was passed over a tension roller and then over damping cylinders by which it became wetted on both sides. It then went to the printing portion. There were two cylinders carrying stereo plates, and two impression cylinders covered with blanket. The paper was fed between the upper printing and impressing cylinders, when one side of it was printed upon; then between other cylinders which gave it an impression on the other side. It then passed to cutting

cylinders, and was cut up into the form of completely printed newspapers, which were delivered by suitable mechanism, in quires or other quantities, but unfolded.

Rotary Web Printing and Folding Machines. The next step in advance was to produce a machine that printed from the web, but, in addition, cut and folded at the same operation. This was achieved by Mr. Geo. Duncan and Mr. W. A. Wilson, of Liverpool, who, in 1870, produced the Victory printing and folding machine. As soon as the sheet was printed and cut from the web, it received a first fold; then it was conveyed to a cylinder from which it received a second fold. It was then delivered to a swinging frame by which folded papers were deposited at a high speed in the receiving boxes.

For some years, while London newspapers were issued unfolded, the leading country papers were folded, and passed over to the agents in a form ready for sale. In due course however, all the London dailies have been folded at the same time as they were printed.

Folding. The best manner of folding newspapers yet introduced consists of what is called the "Former." This is a stationary triangular guide over which the web of paper is drawn, and thereby gradually folded longitudinally on the run. The process is very simple and ingenious. It was first introduced into the machines of Messrs. R. Hoe & Co., and its advantages in folding paper have been such as to surpass all other means of folding.

From the beginning of the twentieth century considerable progress was made in the evolution of the web printing machine. The adoption of stereotyping made it possible to use as many printing machines in the production of a newspaper as was required to print the edition in the requisite time.

The earlier machines were capable only of printing newspapers of 4 and 8 pages. The cheapness of paper, competition, and enterprise led to newspapers being enlarged to 12 pages. Such issues could only be produced at two separate printings, the detached sheets having to be put together by hand. This caused delay and inconvenience, and printers' engineers were called upon to provide machinery that would produce newspapers of a varying number of pages, from 4 to 12 or 16, all inset, cut at the head, and folded in a more convenient form.

The Multiple Web Machine. It was found to be impracticable to produce these different sizes from a single web of paper, and it was therefore necessary to combine two, three, or even four printing presses in one, each printing on a separate roll of paper, the printed webs being carried to one or two folding mechanisms to be automatically cut, pasted, folded, and counted, and made ready for the publisher. The outcome of this was the multiple web machine.

Various types of machines. The following different arrangements have been adopted by engineers :—

1. Two presses at right angles to one another and forming one machine. These are known as supplement or quadruple presses.

2. Two or more presses one working above the other, with connection between each. These are known as two-decker and three-decker machines.

3. Two or more presses, not one above the other, but arranged in a more accessible manner—from the printer's point of view.

4. Two or more presses, one behind another, and capable of being coupled together to form a combined machine. The arrangement is often called the “tandem” system.

5. Two presses arranged with a space between them where the folding mechanism is placed.

The manner in which these principles have been worked out will be seen from the short description which will be given of the web machines now employed.

Opinions differ, of course, as to the relative merits of these different types of machines. For instance, the “tandem” design is objected to on account of the large space it occupies, the inaccessibility of some of its parts, the intricacy of threading the web through the cylinders, and the difficulty of thoroughly watching its working. The No. 3 plan is, it is claimed, more convenient to the printer, as it is readily accessible, and the “plating”—or putting on the stereotype plates—is easily done.

THE HOE ROTARY WEB MACHINES

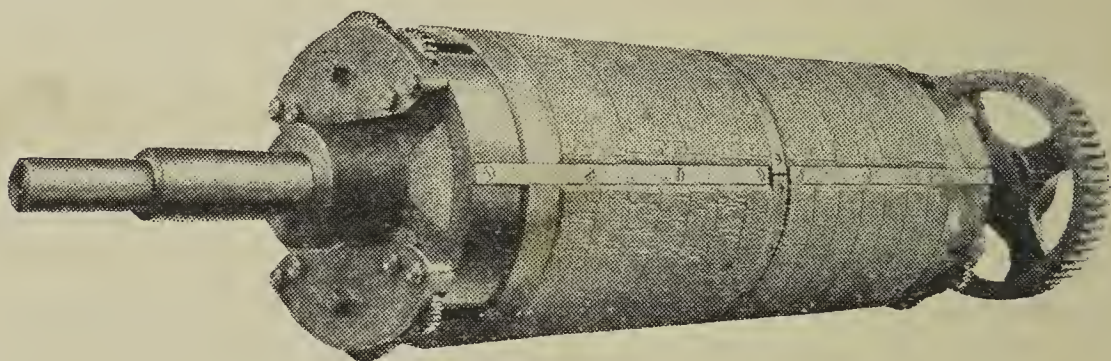
are constructed on the same general principle as that embodied in other machines of this type, but are distinguished from

them by improved designs, by which convenience and accessibility of working parts are combined with the possibilities of highest speed and greatest variety of products.

To the casual observer a large newspaper printing machine presents a combination of intricate mechanism which, in operation, is a maze of solid and whirling metal, through which the streams of paper are pursuing their swift and devious course, making a final plunge of printed matter to reappear as accurately folded copies of a newspaper. Closer attention, however, by the practical man or student will disclose the fact that amid this seeming confusion order reigns throughout, and that the whole machine is composed of distinct units, all of which are practically alike in their purpose and functions.

THE UNIT

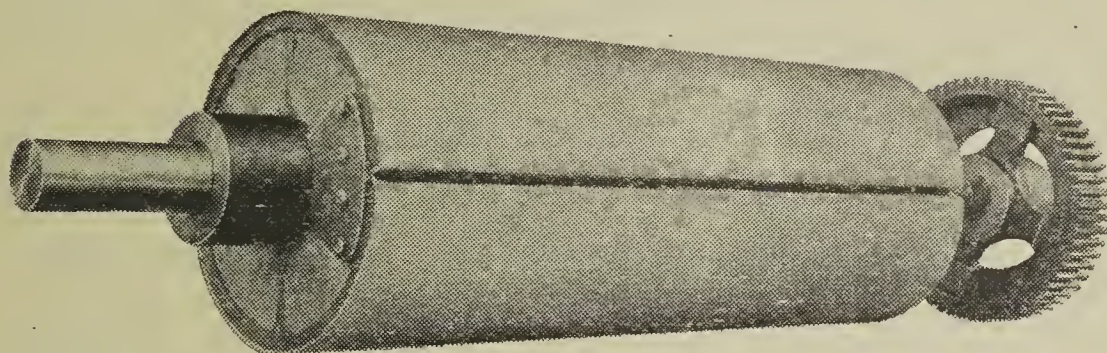
adopted by R. Hoe & Co., consists of two stereotype printing cylinders, each of which has an inking arrangement and impression cylinder co-acting therewith. Each of the stereotype plates is semi-circular in shape, having one page of matter upon its face or periphery. The plates are $\frac{7}{16}$ inch thick, with their curved side edges bevelled, by which clip rings secure them upon the surface of the cylinders. The plates are usually arranged on the cylinders with the columns around, and in this printing unit there are two pages across and two around the cylinder, as illustrated.



STEREOTYPE PLATE CYLINDER WITH FOUR PAGES.

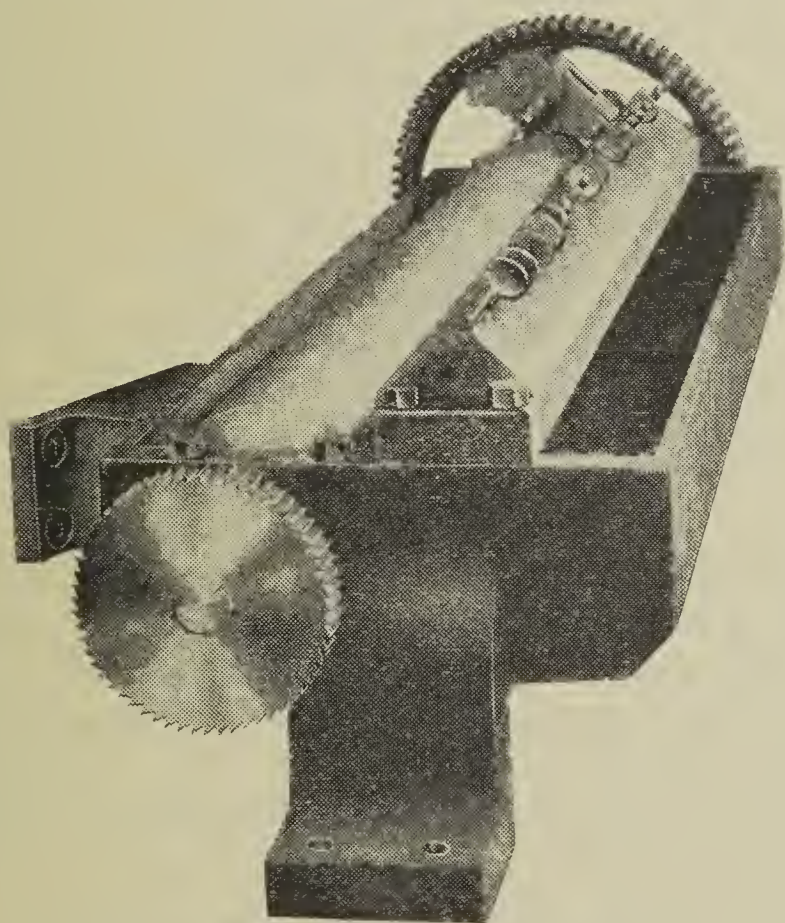
The surfaces of the impression cylinders are covered with a double thickness of blanket, the one next to the metal being of rubber, and the outer one of felt, the thickness of the two being about $\frac{1}{8}$ inch. The felt blanket is sometimes covered with a muslin tympan, more especially on the second or perfecting cylinder, to receive the offset. The blankets and

tympan are secured on the cylinder through an opening in its surface, as illustrated.



IMPRESSION CYLINDER WITH BLANKETS.

The diameter of the impression cylinders over the blankets is the same as that of the stereotype cylinders over the plates, and being geared together by wheels at the outer ends of the shafts, the two surfaces run at precisely the same speed when in contact with the web of paper which passes between them, without tending to tear the paper or slur the printing.



INK FOUNTAIN OF THE OVERSHOT TYPE.

The ink is applied to the plate by two forme rollers of large diameter, although three, four, and even six or eight forme

rollers are employed in machines for printing first-class illustrations such as are in magazines. The forme rollers receive ink from an iron distributing drum, upon which four vibrating rollers or wavers have thoroughly distributed it.

The ink fountain or duct is of the overshot type, in which the blade, regulated by a series of screws as usual, is placed at the top of the roller, the rotation of which may be made intermittent or continuous by means of an ingenious device which enables the operator to control the supply suitably to the character of the printing. By means of the usual oscillating roller the ink is conveyed from the fountain roller to a small iron drum, from which it is transferred to the distributing drum before-mentioned, and to the forme rollers and printing plates.

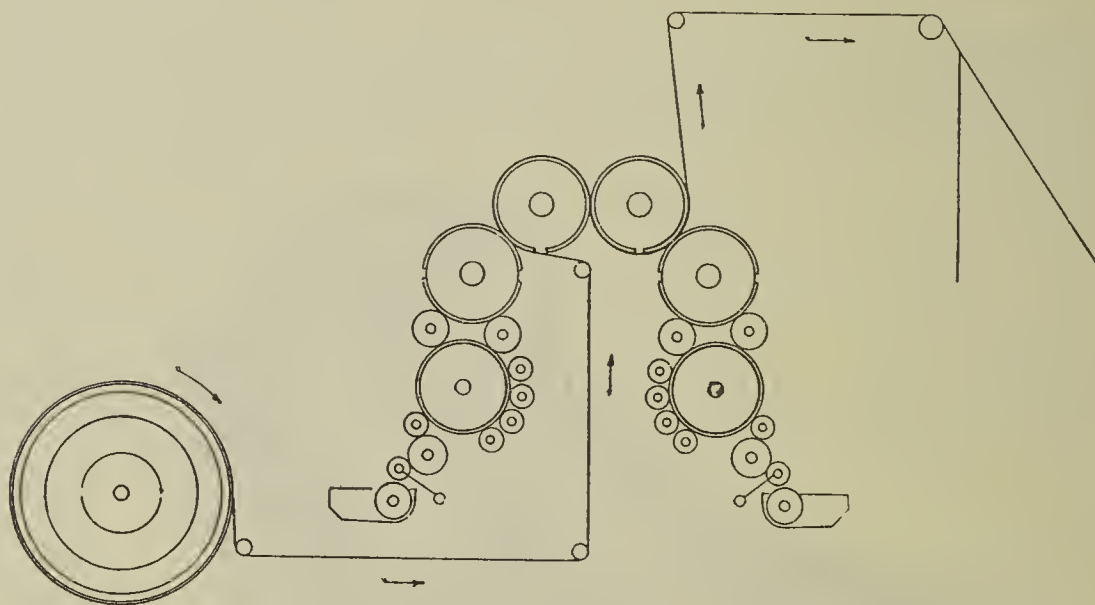


DIAGRAM OF PRINTING CYLINDERS AND COURSE OF WEB
FROM REEL TO FOLDER.

The several elements referred to above may be grouped in any manner that may be most desirable, having the centres of the printing cylinders either in a horizontal line or at an angle with one another. The diagram illustrates an approved arrangement, and also the course of the web as it passes from the reel at one side of the printing mechanism to the folder at the opposite side.

Forged steel shafts are fitted in all the cylinders and run in journal boxes lined with gun-metal and provided with the best facilities for lubrication. Free running rollers over which the web passes, and which serve to guide it in its

course, are mounted in ball bearings so as to revolve easily and cause no stress upon the web which drives them. The tension of the web is regulated by means of a friction brake upon the spindle of the reel, and means are provided for adjusting the brake either at the reel or, where there is more than one reel, at a centrally located station from which they may all be regulated. When there are many units in a large machine, and some of the webs consequently have a long travel, contact with the printing surface is not alone sufficient to propel them. Geared rollers are then provided, upon which rubber-faced rollers about 3 inches diameter and $\frac{3}{4}$ inch wide, carried by separate arms, are brought to bear, and serve to perfectly control the draught of the web and prevent breakage or undue strain upon it.

It will be understood from the foregoing description that

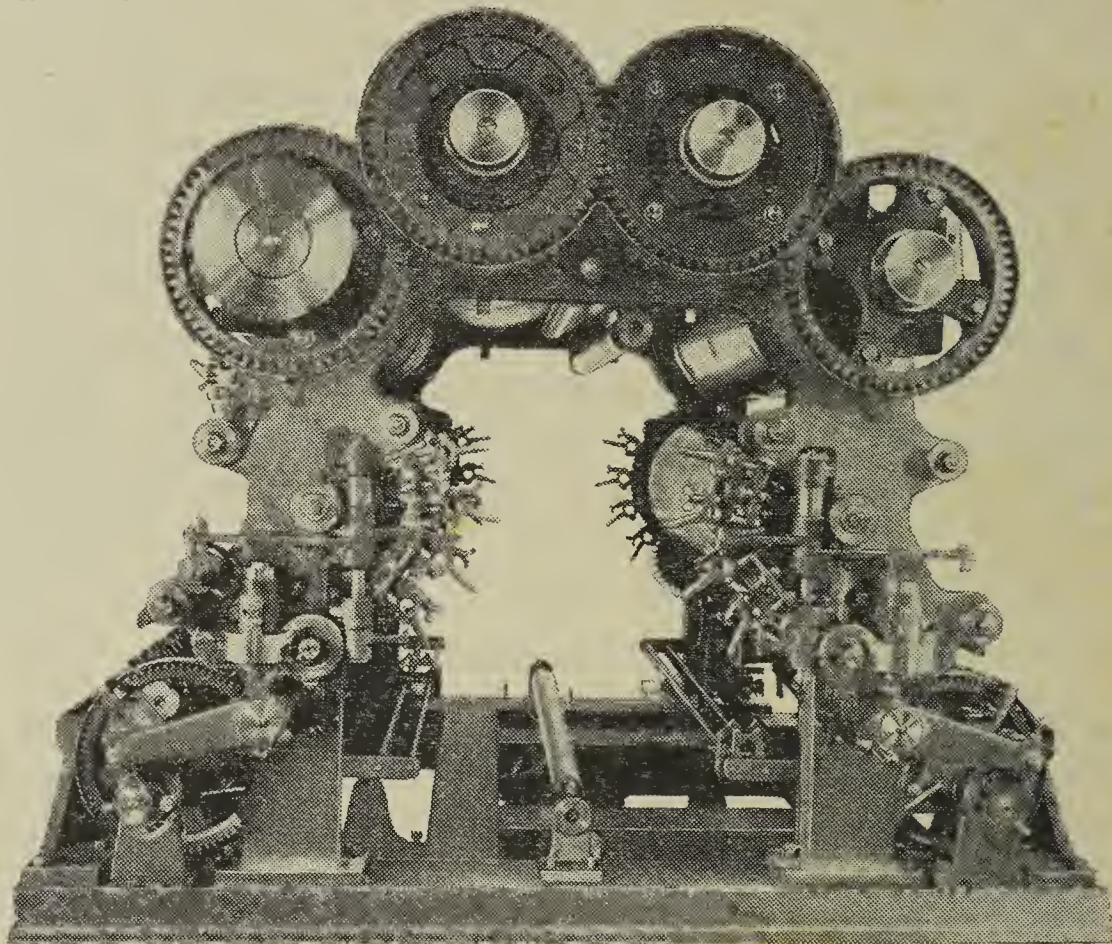
A SINGLE PRINTING UNIT

is one having four pages upon each plate cylinder, the pages on one half of the cylinder being duplicates or not of those of the other half, and the unit is therefore capable of printing four pages on each side of the web and producing either two four-page copies or one eight-page copy at each rotation of the cylinders. Any desired number of these units may be arranged to operate together in one machine. They may be located one over another, or, where the height of a machine-room is not sufficient, they may be arranged in two groups or sections on the floor in alignment with each other.

CLASSIFICATION OF MACHINE.

The type of machine is designated by the number of units of which it is composed, as indicated by the number of reels which are required; thus, a single-reel, two-reel, or three-reel machine designates a machine that is composed of either one, two, or three units, usually provided with a single folder and capable of producing either 8, 16, or 24-page copies respectively, as a maximum product. Similarly, four, six, or eight-reel machines are composed of four, six, or eight units which are arranged in two groups or sections with a folder for each section. This enables their operation as two distinct machines if desired, or, alternatively, the printed webs from

both sections may be associated and run through either one of the folders, forming a combined product from the whole machine.



ONE PRINTING UNIT AS IT APPEARS IN A MACHINE, THE INKING ROLLERS HAVING BEEN REMOVED.

Single-reel machines have been made carrying three pages across their cylinders, and capable of producing two 6-page copies or one 12-page copy at each rotation. These presses are known as three-page-wide machines, and, in several instances, a unit of this width has had another of the same width placed above it and an additional folder provided, thus forming a two-reel three-page-wide machine, capable of producing four 6-page or two 12-page copies as a maximum product.

Machines are also made of sufficient width to have cylinders carrying four pages across instead of two or three, in which case their capacity is, of course, double that of the two-page-wide machines. Although the cylinders of these presses are extremely long, the novel method employed in their construction renders them absolutely rigid while under impression and

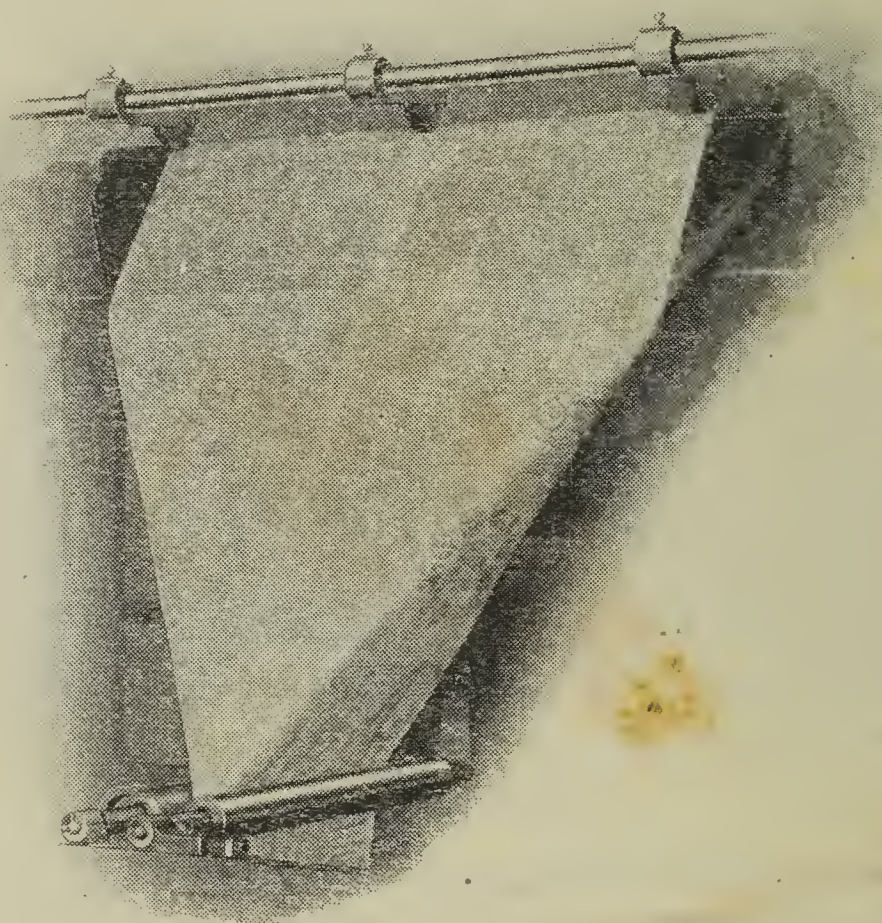
running at high speed. Another feature of the four-page-wide cylinders that makes it quite possible to run them with a heavy impression at high speed is to place the margins along the cylinder for the two pages at one end, out of alignment with the margins for the two pages at the opposite end of the cylinder. This invention, commonly known as "staggering" the plates, was a solution of a difficulty that attended the operation of wide presses at high speed, as it effectually prevents the jumping of the cylinders that formerly occurred when the transverse margins were continuous along the cylinder, and the impression was relieved and taken up again every time the printing ceased during the passage of the margins at each half revolution of the cylinders.

The nomenclature of the four-page-wide machines is as follows :—One having a single reel is a double machine, with two reels a quadruple, and one having three reels a sextuple machine. Two folders, placed side by side and designated as a pair of folders, are ordinarily attached to machines of this class. Octuple, double sextuple, and double octuple machines have four, six and eight four-page-wide reels respectively, and are arranged in two sections having two, three, or four double units, each section being provided with a pair of folders and capable of operating independently or in combination with the other.

THE FOLDERS

attached to these printing units are of the "former" type, which was first introduced by R. Hoe & Co. in the construction of fast printing machines. The two-page-wide webs first pass over a triangular-shaped former, by means of which a longitudinal fold along the centre margin is produced, as illustrated. The rollers under the former feed the folded webs to the cutting cylinders, one of which is provided with means for giving a transverse fold and is known as the folding cylinder. The leading edge of the longitudinally folded web is seized by pins in the surface of the folding cylinder, and carried by them until the middle of a page length is opposite to a pair of rollers, between which it is thrust by the action of a rotating blade and folded to half-page size. The sheet is at the same time severed from the incoming web by a saw-toothed cutting knife mounted in the

other cylinder, and the newly-formed edge of the advancing web is seized by the pins in the folding cylinder and carried around it, to be folded in like manner to the previous sheet. The cutting cylinder in which the knife is mounted is of one half the diameter of the folding cylinder, and its circumference is equal to one page or sheet length. This is to enable it to



TRIANGULAR OR V-SHAPED FORMER FOR PRODUCING THE
LONGITUDINAL FOLD.

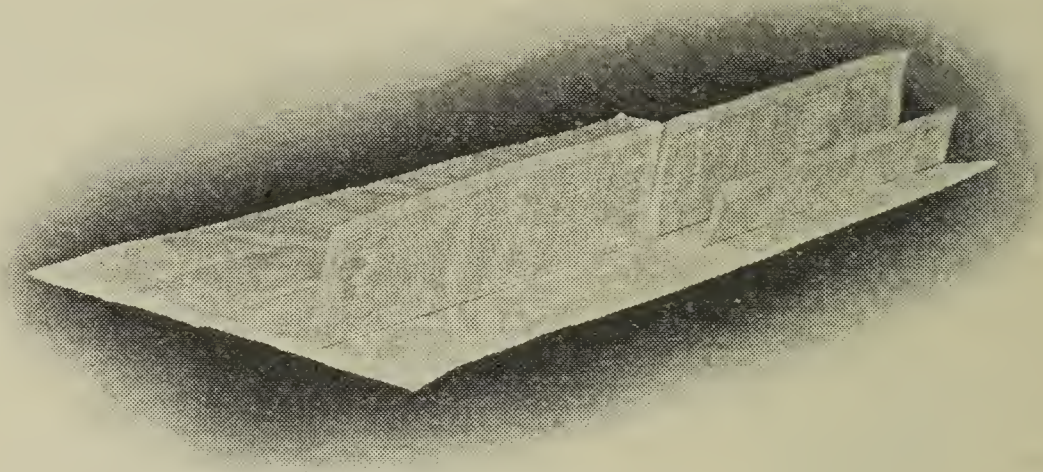
act as a collecting cylinder when two sheet lengths are to be associated with each other to form a single copy. When two sheets are to be thus associated or collected, the first of them is seized by pins in the surface of the cutting cylinder, instead of by the folding cylinder pins, and carried by them around the cylinder for one rotation, when the sheet is taken with the succeeding sheet by the pins of the folding cylinder, and the two sets of pages are folded together by the rotating blade. After passing between the folding rollers, the copies drop into the curved arms of a revolving fly, which deposits

them in a horizontal position on a slowly moving apron made up of several leather belts. In order to facilitate the bundling of the products in the despatch room, quires of any required number are indicated upon the delivery of the machine by causing the copy completing the quire to be laid about three inches out of the regular order. This is done by the movement of a stop at proper intervals, which prevents the counted copy from being carried as far around the fly as its fellows. The copies thus delivered and counted are folded to half-page size, but it is sometimes required that they should be folded to quarter-page size, in which case an additional mechanism is supplied, known as a quarter-page folder. When this folder is attached to the machine, copies folded to half-page size are directed from the folding rollers to a rotating blade at a right angle to the folding cylinder, and are thrust between a pair of rollers and receive an additional fold to quarter-page size, being delivered upon travelling bands in the same manner as described above.

It will be remembered that two page lengths are printed at each rotation of the cylinders, and it is obvious that if a single web is folded over the former, a four-page copy will be obtained at each cut, and if the first sheet passes around the collecting cylinder and is associated with the second sheet, an eight-page paper is obtained, composed of two four-page sections. This product is referred to as being folded "back to back" or as a collected product.

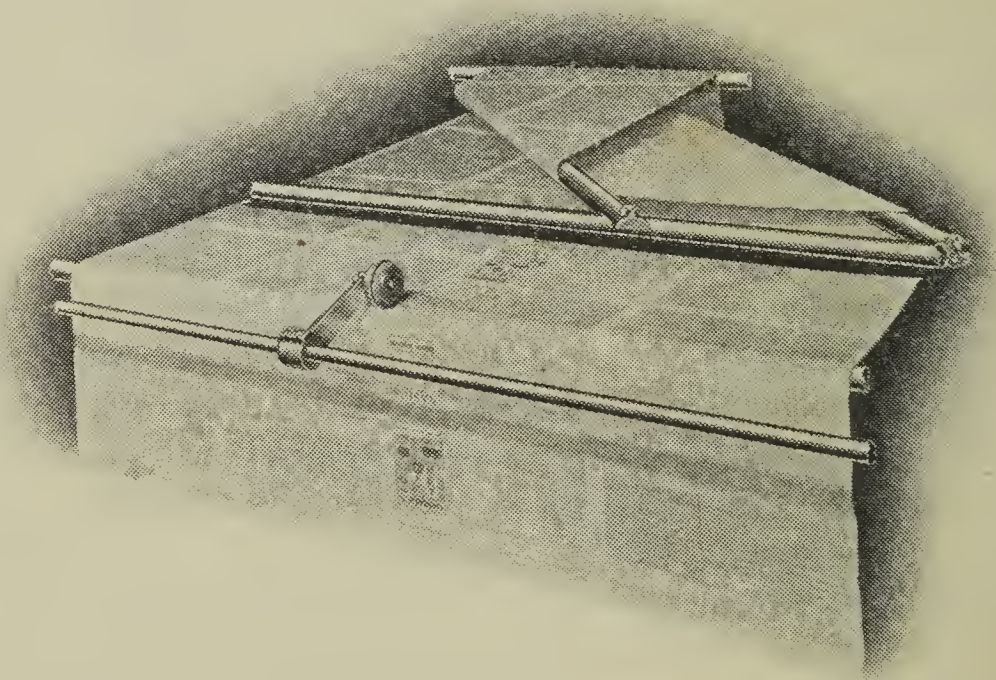
When the webs from two units are associated before passing over the former, a two-ply web is formed, and it is evident that an 8-page copy with inset pages will be obtained at each cut, and 16-page copies will be obtained as a collected product. Webs from three units would thus form an inset 12-page copy or a collected 24-page copy. If 6 or 10-page copies are required it will be seen that the webs from one of the units should be of half-width only, thus forming a two-page sheet. The accompanying illustration will show how these combinations are made, and it will be understood that the number of pages in an inset product may be varied by two pages within the limits of the capacity of the machine.

In four-page-wide machines, two folders are placed side by



SHOWING ASSOCIATION OF WEBS TO FORM 10-PAGE COPY.

side, or as a pair, and the four-page-wide web is divided in the middle by a rotary splitter at the moment it reaches the formers. The two-page-wide webs thus formed pass over the formers, and the products are delivered separately from each folder. If it is desired to associate these two half-width



METHOD OF DIVIDING A FOUR-PAGE-WIDE WEB AND ASSOCIATING THE TWO HALF-WIDTHS.

webs, the wide web is divided before it reaches the formers, and one of the half webs passes over diagonal turning bars as shown in the illustration, and thus brought into line with the other half web and the two together pass to one of the folders.

PASTING.

Means are also provided by which the pages receive a line of paste along the centre margin to unite them before running over the former. This is done by a knife-edge disc revolving in a small reservoir of paste, provided with a scraper which regulates the quantity of paste carried by the edge of the disc, but the pasters are seldom used except for securing two-page inset sheets.

RUNNING SPEEDS.

The speed at which the printing cylinders rotate is 18,000 revolutions per hour, and the products obtainable from the several sizes of machines described are shown in the following tables, the figures in the columns indicating the number of pages in each copy :—

TWO-PAGE-WIDE MACHINES WITH ONE FOLDER.

	SINGLE-REEL.	TWO-REEL.	THREE-REEL.
Inset copies, at 36,000 per hour	4	4, 6, or 8	4, 6, 8, 10, or 12
Collected copies, at 18,000 per hour ...	8	8, 12, or 16	8, 12, 16, 20, or 24

TWO-PAGE-WIDE MACHINES WITH TWO FOLDERS.

	FOUR-REEL.		SIX-REEL.		EIGHT-REEL.	
	“A”	“B”	“A”	“B”	“A”	“B”
Inset copies, at 36,000 per hour	4, 6, or 8	10, 12, 14, or 16	4, 6, 8, 10, or 12	14, 16, 18, 20, 22, or 24	4, 6, 8, 10, 12, 14, or 16	18, 20, 22, 24, 26, 28, 30, or 32
Collected copies, at 18,000 per hour	8, 12, or 16	20, 24, 28, or 32	8, 12, 16, 20, or 24	28, 32, 36, 40, 44, or 48	8, 12, 16, 20, 24, 28, or 32	36, 40, 44, 48, 52, 56, 60, or 64

“A” = Separate products from each of the two folders when sections are operating independently.
“B” = Combined product from one folder only when two sections are operating together.

FOUR-PAGE-WIDE MACHINES WITH
ONE PAIR OF FOLDERS.

	DOUBLE.		QUADRUPLE.		SEXTUPLE.	
	"A"	"B"	"A"	"B"	"A"	"B"
Inset copies at 36,000 per hour	4	6, or 8	4, 6, or 8	10, 12, 14 or 16	4, 6, 8, 10, or 12	14, 16, 18, 20, 22, or 24
Collected copies, at 18,000 per hour	8	12 or 16	8, 12, or 16	20, 24, 28, or 32	8, 12, 16, 20, or 24	28, 32, 36, 40, 44, or 48

"A" = Separate products from *each* folder of the pair.

"B" = Combined product from one folder only of the pair.

FOUR-PAGE-WIDE MACHINES WITH
TWO PAIRS OF FOLDERS.

	OCTUPLE.		DOUBLE SEXTUPLE.		DOUBLE OCTUPLE.	
	"A"	"B"	"A"	"B"	"A"	"B"
Inset copies, at 72,000 per hour	4, 6, or 8	10, 12, 14, or 16	4, 6, 8, 10, or 12	14, 16, 18, 20, 22, or 24	4, 6, 8, 10, 12, 14, or 16	18, 20, 22, 24, 26, 28, 30, or 32
Collected copies, at 36,000 per hour	8, 12, or 16	20, 24, 28, or 32	8, 12, 16, 20, or 24	28, 32, 36, 40, 44, or 48	8, 12, 16, 20, 24, 28, or 32	36, 40, 44, 48, 52, 56, 60, or 64

"A" = Separate products from *each* pair of folders.

"B" = Combined products from one pair of folders only.

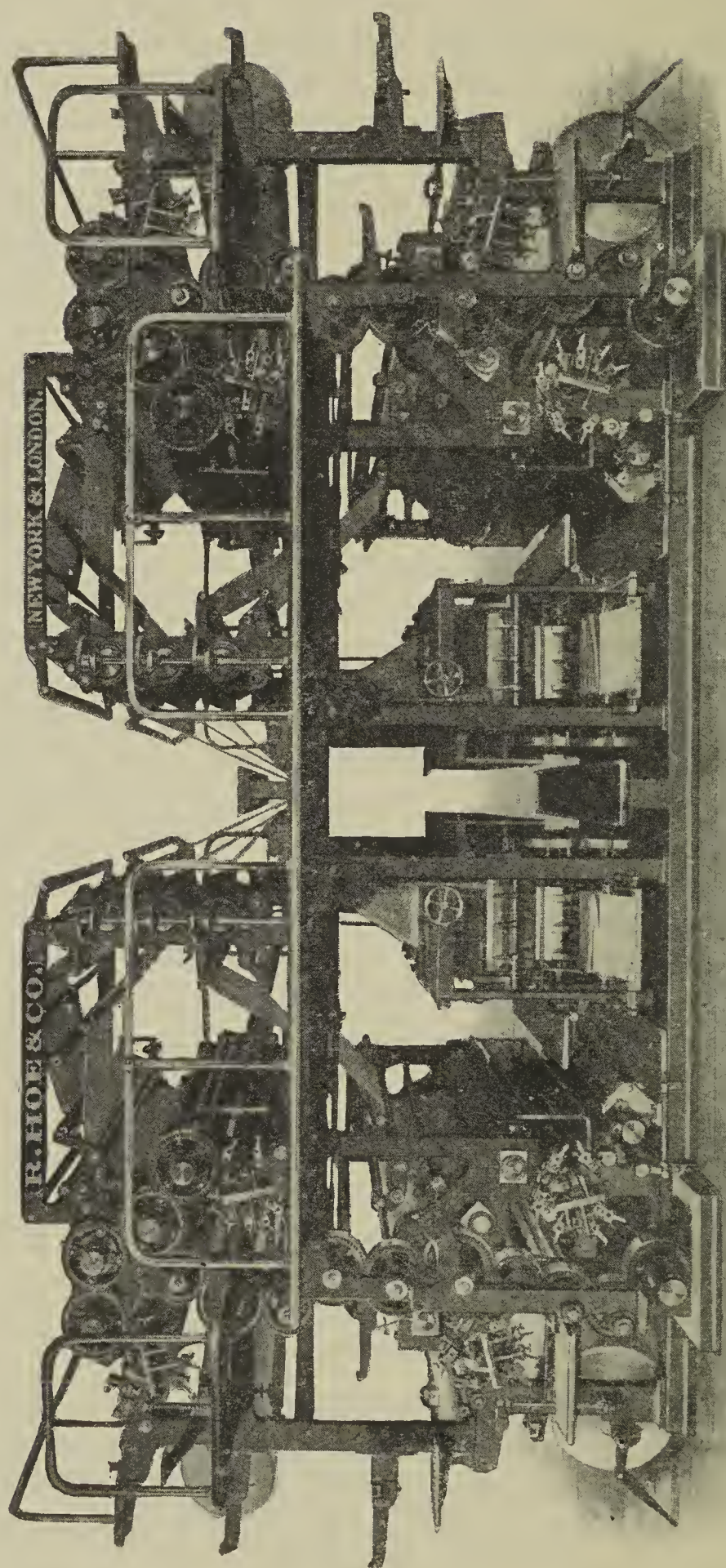
If it is required to produce an inset eight-page product from a single printing unit, an "insetting" folder is provided. In this folder the sheet lengths are cut before passing over the former, and two consecutive sheet lengths are collected on the cutting cylinder before they receive the longitudinal

fold over the former. Two and three-roll machines with inseting folders are also made, and so arranged that one of the printing units may operate at one-half the speed of the others, and the machine is capable of printing two-page sheets on a half-width web and associating them with the four-page sheets from the other units before the longitudinal fold is made, in order to obtain inset copies with the number of pages varying by two's without requiring a double set of plates throughout as in the larger machines.

While the standard machines of R. Hoe & Co.'s manufacture are arranged to print with the pages around the cylinders, as described, they also make machines in which the pages have their columns along the cylinder, and this type is especially desirable in smaller provincial offices where a limited quantity of copies is required, and a single set of stereotype plates only is desired for any given product. The cylinders of these presses have two pages around and two pages across, so that in one printing unit one complete four-page copy may be printed by a one-page-wide reel at each end of the cylinder, and by associating the two single-width webs from the unit by means of diagonal turning bars an eight-page copy is obtained. One type and impression cylinder of the unit can be operated independently of the other if desired, and the web printed at one end of the cylinder on one side can be transferred laterally by means of turning bars and receive an impression upon the reverse side from the plates at the opposite end of the type cylinder, thus producing a complete four-page copy from a single set of printing cylinders. This set of cylinders can be arranged to run at one-half the speed of the other set in the unit, and it is obvious that two-page sheets can thus be printed by one set of cylinders and inserted with four-page sheets printed by the other set running at full speed, and thus produce a six-page paper.

ENLARGEMENT.

It will be apparent that presses of this type may be grouped together, and it is therefore such a machine as a small office can install and add to subsequently when the growth of the newspaper demands that it should have an increased number of pages.



A FOUR-REEL FOUR-PAGE-WIDE OR OCTUPLE MACHINE WITH TWO PAIRS OF FOLDERS CENTRALLY LOCATED.

FUDGING.

Many of the rotary presses are provided with "fudging" or stop-press devices, by means of which late news can be printed. This device has an auxiliary printing cylinder and inking arrangements, and type or linotype slugs are locked in segmental beds secured to the surface of the cylinder and print upon a blank space left in the column of the page. A separate impression cylinder is sometimes provided for this printing, but it is more usual to print the late news upon the same impression cylinder as co-acts with the stereotype cylinder.

STITCHING.

The folders are often equipped with a rotary wire stitching device for securing the pages of a product instead of pasting them, and this is found especially desirable where periodicals containing a large number of pages are required.

R. Hoe & Co. also manufacture many other types of rotary machines adapted to the production of magazines and periodicals in which half-tone illustrations of the finest character are printed. Cover pages of different quality of paper may be associated and stitched to them so that the whole product will be completed in the machine.

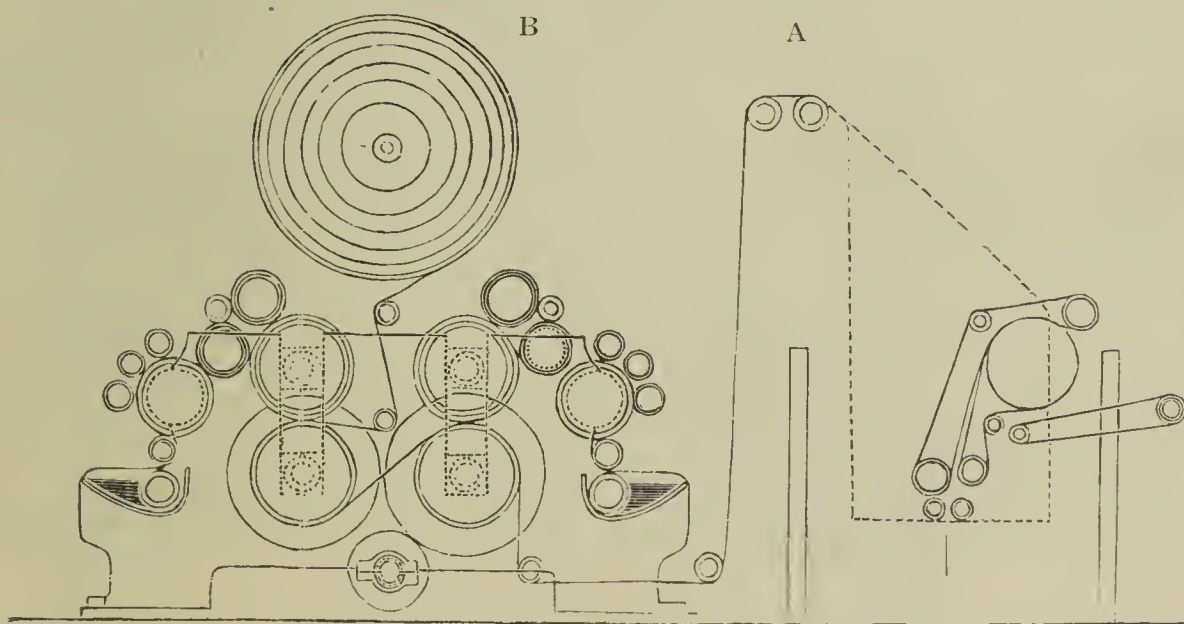


FIG. 32. VICTORY SINGLE WEB MACHINE.

The Tandem Web Machine. This principle, adopted in the Victory machines, was invented by Mr. G. A. Wilson, of

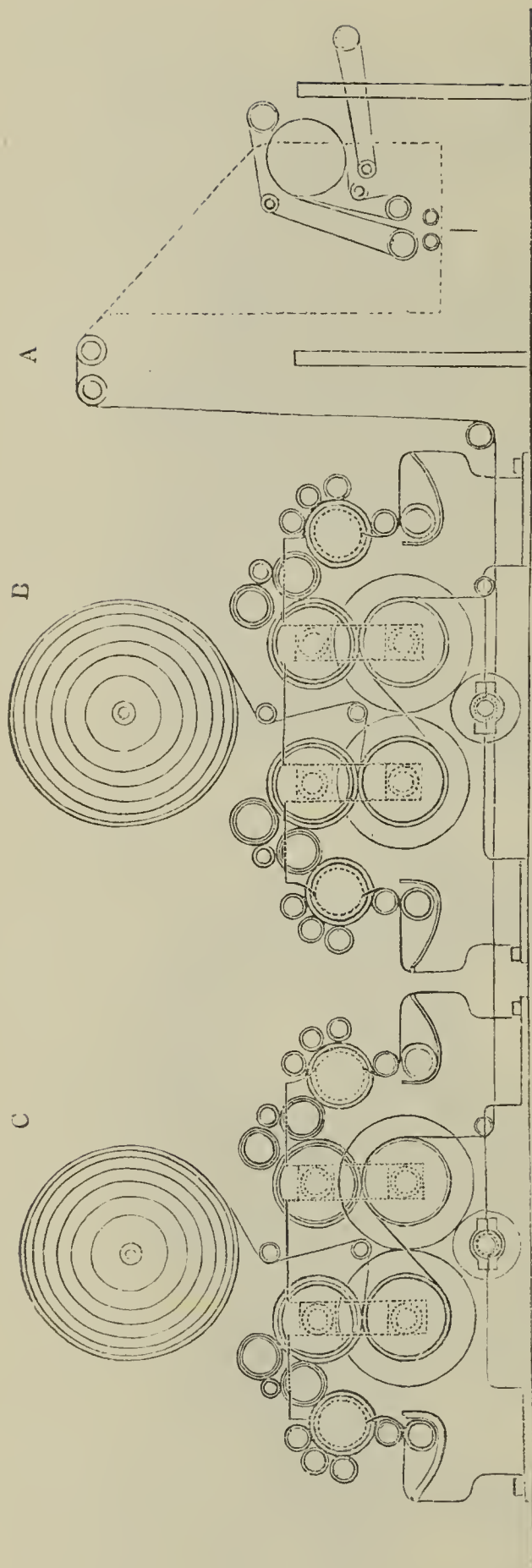


FIG. 33. TWO-REEL VICTORY MACHINE WITH ONE FOLDER.

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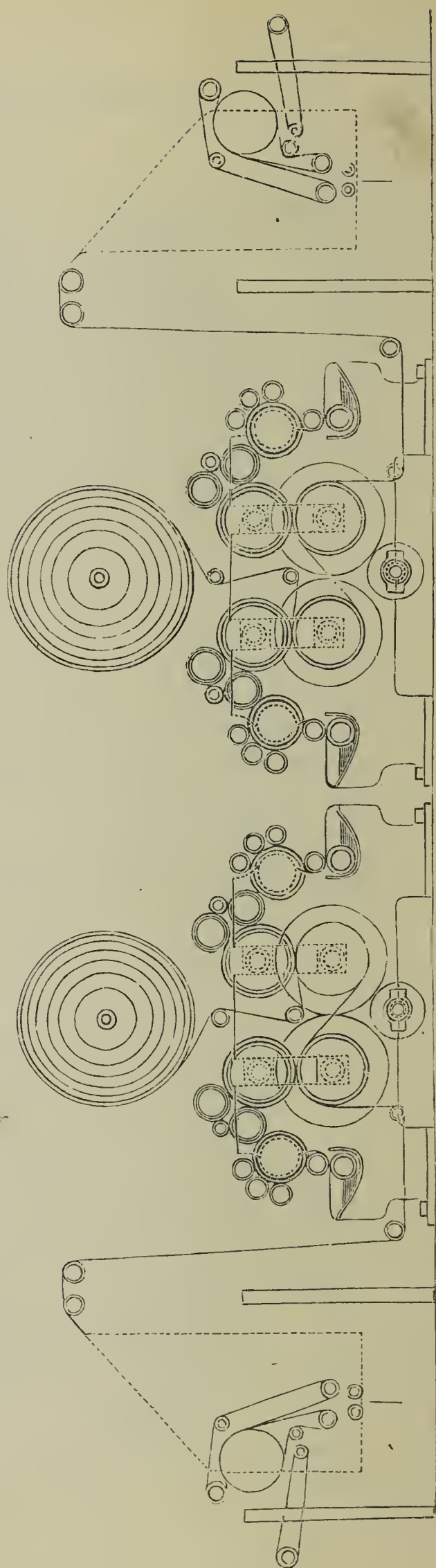


FIG. 34. TWO-REEL VICTORY MACHINE WITH TWO FOLDERS.

Liverpool, and consists in combining two or more machines all on the same level, each of which is capable of being worked independently of the others.

In Fig. 32 is shown the general arrangement of a single-reel Victory machine, B, with one delivery apparatus, A. Such a machine will print a 4-page paper at the rate of about 24,000 copies per hour. The highest part is about $3\frac{1}{2}$ -ft. above the level of the floor, which is considered an advantage, as when a ladder is needed to see the top of the machine there is a temptation to neglect that portion, and stoppages and accidents result from want of proper attention to this part. If it should be desired to produce a 6 or 8-page paper, another 4-page machine can be coupled on, as shown in Fig. 33 and Fig. 34.

As in Fig. 32, A and B represent the first 4-page printing and folding sections. The second 4-page printing section is represented by C. The mechanical connection between C and A, and therefore between C and B, is a bolt, connecting the driving shafts of C and A, which can be removed or attached at will. It results that A and B can be run until the new section is ready, and then the two webs can be directed into the folder, and an 8-page paper produced. If a 6-page paper is desired, a half-width reel may be mounted on either sections, a paster can be brought into requisition, and a 4, 6, or 8-page paper will be produced, folded and pasted at command, without mechanical alterations.

The Ammand Web Machines. The diagrams 35, 36, and 37 illustrate the form and design of some of the web printing and folding machines made by the Northern Press and Engineering Co., Ltd., South Shields. The type cylinders are distinguished by the letter T, the impression cylinders by E, and the inking apparatus by I. Fig. 35 shows the ordinary 4 and 8-page machine made by this firm. Fig. 36 shows the same machine with a second press built on the top of it. Fig. 37 shows a three-roll printing machine with double folders.

In a machine where there are three printing mechanisms and two folders it becomes an important question as to the best means of arranging the different mechanisms so as to occupy comparatively small space, to have as short a travel

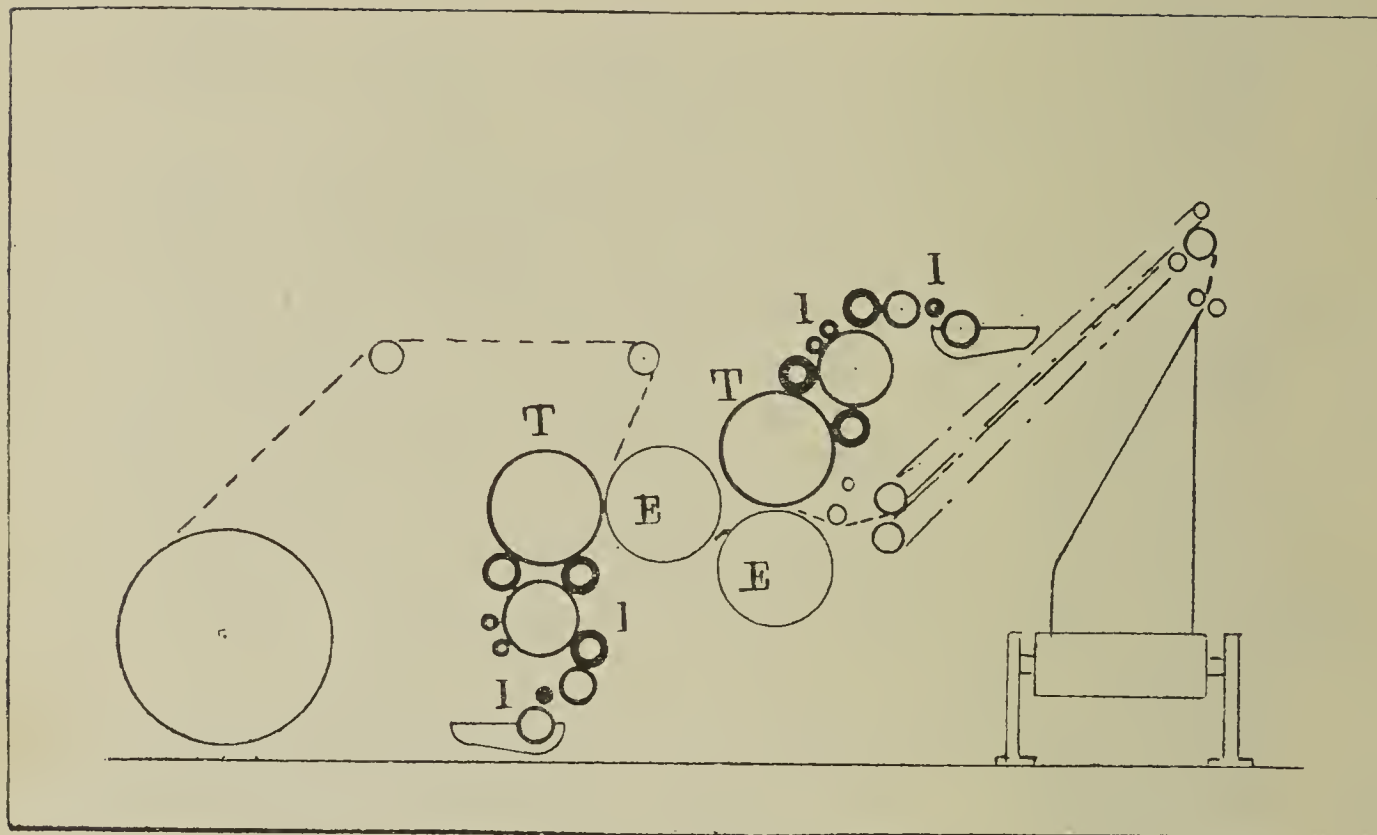


FIG. 35. ANNAND SINGLE-ROLL MACHINE.

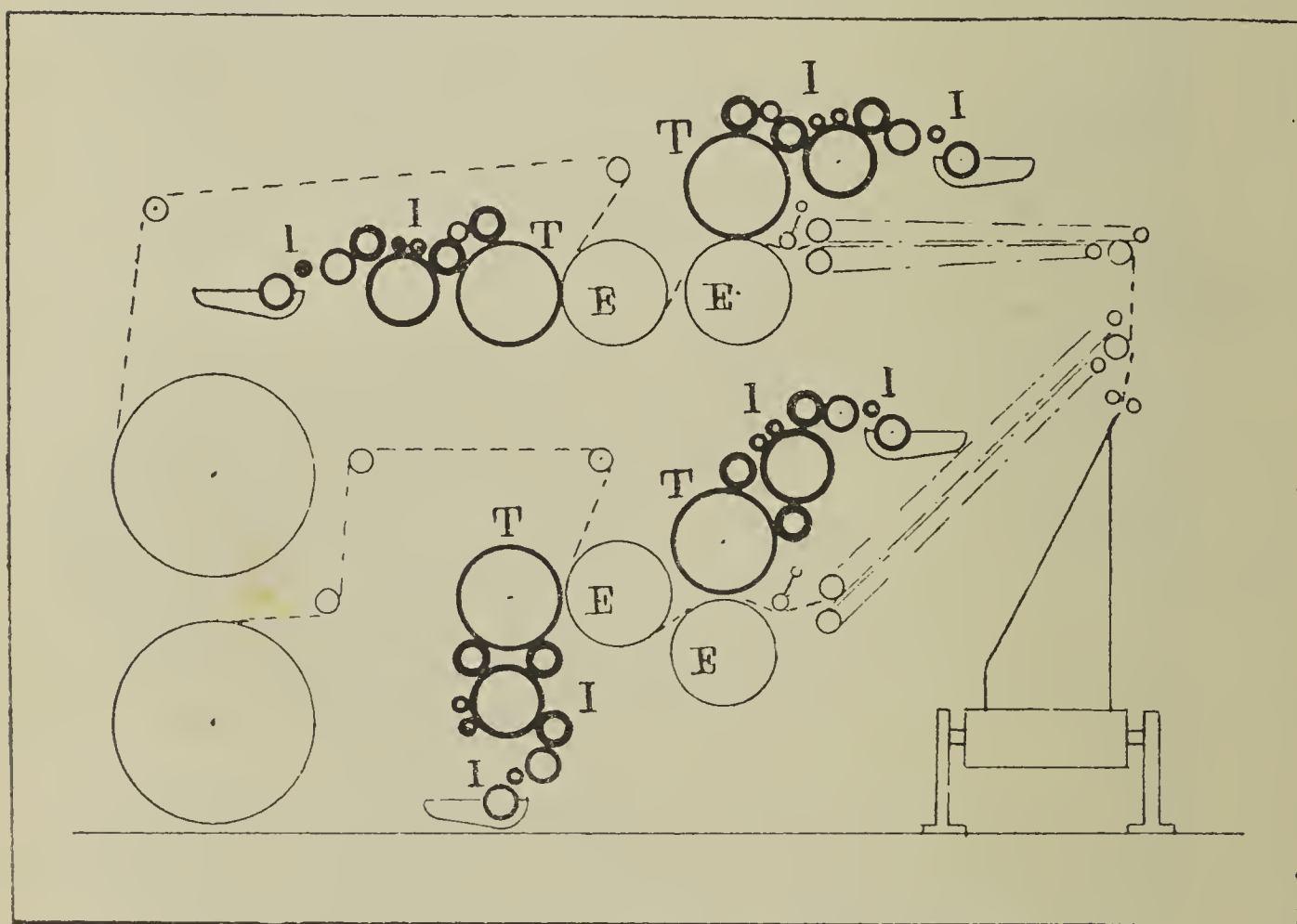


FIG. 36. ANNAND DOUBLE-ROLL MACHINE.

as possible for the webs after they are printed, and also allow freedom for the attendants to get about the machinery without injury. Hence these presses are arranged at both ends with a space between them for the folding mechanism, and the third press is placed on a plane above the end printing press and folder. A fourth printing mechanism can at any time afterwards be added. In this arrangement the unprinted rolls of paper are placed outside on the machine, and can be readily renewed as they are used up. After the webs of paper are printed, they leave the printing presses on the inside, and all converge in the direction of the folders, where there are contrivances by which the attendants can direct the webs to one or other or both of the folders. For instance, if the machines are printing a 4-page paper only, two printing presses are used, and two folders. The two printed webs when they reach the top of the folder are separated, the one being directed to the left-hand folder and the other to the right-hand folder. A 4-page paper of full size is by this means produced at the rate of 48,000 copies an hour on each machine, or about 800 copies per minute per machine. A 6-page paper can be produced by using the third printing press, and after the web is printed it is slit into two half-webs, the one is put underneath the full web from the right-hand machine, and the other under the web of the left-hand machine, and thus a 6-page paper is produced with the inner 2 pages pasted inside the other 4 pages. An 8-page paper is produced by switching two of the webs to either of the folders. A 10-page paper is obtained by using two full webs and a half, and directing them to one folder. A 12-page paper is produced from three full webs directed to one folder.

The Annand Folder is a development of the Former already referred to. The object of its inventor was to make it as simple and compact as possible. A machine for printing and folding a large 8-page paper, exclusive of the reel, occupies 10-ft. by 8-ft. of floor space. The length of web in the machine between the reel and the cutting cylinders is so short that variation in speed or in tension does not affect the cutting and folding to register. The first fold is given to the web by passing it over the fold-former, and lapping the two sides of the web together while on the run.

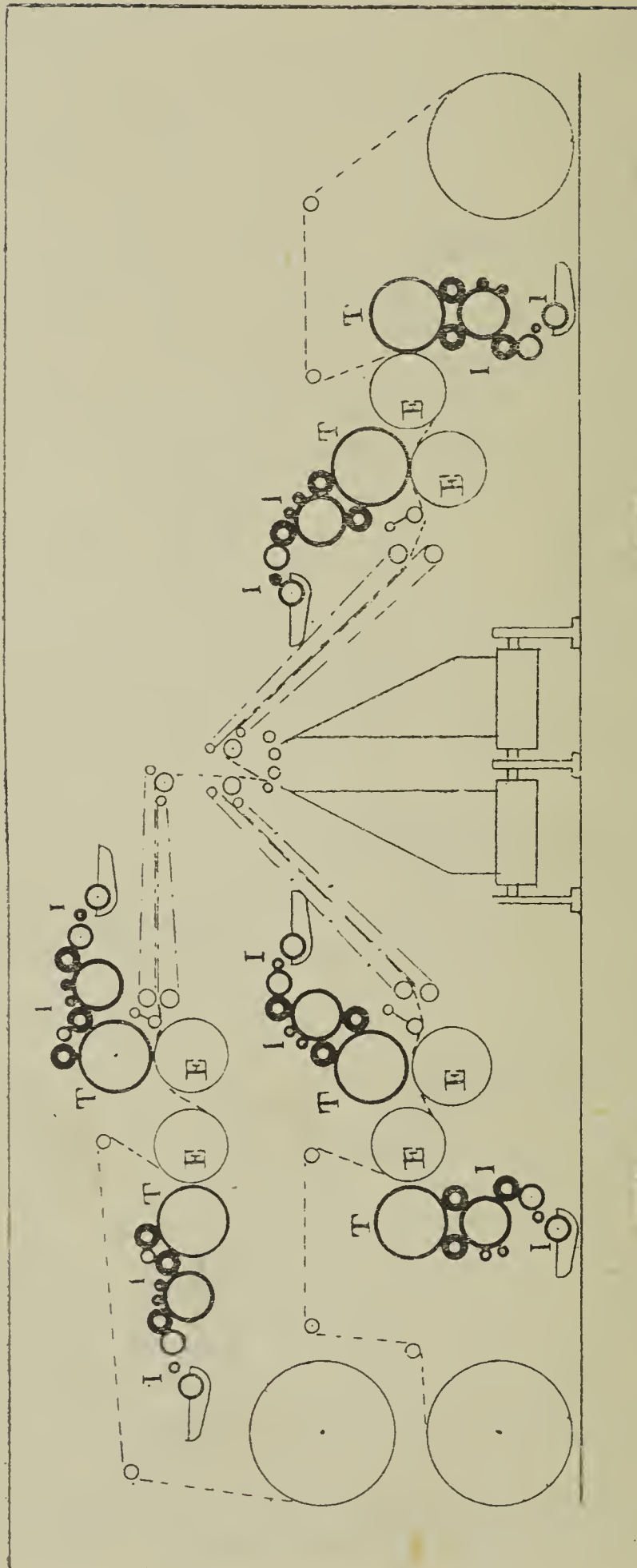


FIG. 37. ANNAND THREE-ROLL MACHINE WITH DOUBLE FOLDERS.

The web, after it is folded longitudinally, passes in between transverse cutting and folding cylinders that fold and cut it into the form desired, the last folding cylinder acting at the same time as a rotary flyer, which piles the sheets in a regular manner upon an apron of leather bands moving slowly forward, and by a sudden side movement at regular intervals counting the product into any predetermined number.

Considerable ingenuity is displayed by printing machine engineers in providing presses to meet all manner of exacting conditions. This refers alike to size of paper and speed of production, as well as the position, space and height of the accommodation available in the newspaper pressroom. Such firms as R. Hoe & Co., Ltd.; The Northern Press and Engineering Co., Ltd.; The Victory Machine Co., Ltd.; Joseph Foster & Sons; and the Goss Printing Press Co., Ltd., may be mentioned as eminent British houses successfully specialising rotary press manufacture. As an instance of this, a machine built for the office of the *Pall Mall Gazette*, London, by the Goss Printing Press Co., Ltd., may be briefly described here.

This sextuple rotary press was specially designed for the office, and the three sets of printing cylinders are arranged in three independent sections, all on one level, with the folder at one end of the machine. A platform four feet high on both sides makes an elevated floor, from which access can be had to the cylinders and the rollers by any man of average height. A subsidiary platform gives access to the fudge, which is an independent mechanism and perfectly open and get-at-able.

The reels of paper are placed underneath, two reels to each section, and mounted on carriages travelling on rails below the machine-room floor level. When the machine is working at full capacity three reels are used—one in each section—the other reels being spares. When the first reel is spent the spare reel is connected to the end of it, and the exhausted reel replaced by a fresh one. Reels are lifted into the carriages from the floor by means of a pair of levers. The carriages are held in place underneath the press by a latch device. A simple lever gives the side lay immediately.

Connected with the brake shoes is a lever, from which a

flexible wire runs to the folder. The wires for the two reels under each press section are joined to a single wire, and the tension on all the reels can be regulated by means of three hand-wheels at a control station near the folder. Inking rollers are arranged in movable frames, whereby the distributing rollers and the inner forme rollers in each set are moved away from the cylinders and ink drums by the turning of a hand lever. No rollers need to be removed when plating cylinders, and the cylinders are all timed together.

The forme cylinders are fitted with the ingenious Goss lock-up, by means of which the four dogs which hold each stereotype plate can be locked simultaneously by a half-turn of a key. Register rollers are provided for all the webs and controlled by means of hand-wheels at the folder.

The main driving shaft is situated underneath the platform and extends the whole length of the machine. The drive is by means of a noiseless chain from a motor on the floor at the rear of the machine. This is housed in a localised cleverly-devised and dust-proof power house, with every section bolted together and fitted with lifting handles, so that in case of any accident it can be immediately removed and free access to the motors obtained. Control push buttons are provided on both sides of the press and folder. All mechanisms are above the floor level, so that there is no necessity for a pit underneath the machine.

The guaranteed running speed of the machine is 36,000 per hour from four up to twenty-four pages, delivered and folded to half-page size.

The general aim of the design has been to minimise the labour of attending to the machine, to facilitate access to every part, and, in short, to render the general course of the work as nearly straight-line as possible. So successfully has this been accomplished that many of the delays apparently inherent to rotary presses are entirely obviated, and the labour of handling has been very substantially reduced in details of plating, working, leading paper, and so on.

CHAPTER XV.

FLAT-BED WEB MACHINES.

THIS class of machine, as its name implies, prints from a forme or formes, on a flat bed or beds, from a reel of paper, not from single sheets. Such machines also have attached cutting apparatus and a folder, thus being entirely automatic.

The invention of the rotary press for the great dailies, with their large and increasing circulations, left a great gap between that class of machine and those in general use, which consisted of the ordinary single-cylinder or Wharfedale type, the perfecter and the two-feeder. There were springing up all over the country weeklies and evening papers, whose needs, whilst not large enough to call for the installation of rotaries and the stereo foundries, required machines that would enable them to give the public the latest news in the shortest possible time. It was this demand that led to the invention of flat-bed web machines.

In America were built the Duplex and the Multipress, in Germany the Hamm and Hellman, whilst in England the Lancashire was put on the market.

Flat-bed web machines may be divided into two main classes :

1. Those with movable type beds or tables, on the Wharfedale principle.
2. Those with fixed beds and movable cylinder or cylinders.

This class of machines is built with either one or two cylinders.

The Duplex Flat Bed. This press has two stationary beds, one above the other, firmly bolted to the side frames ; the two impression cylinders, being journalled into a common crosshead, are intermittently reciprocated over both beds. The web of paper is conveyed by simple devices between the

lower bed and its cylinder, then round the end of the press and over the upper bed and under the top cylinder, from which it travels to the cutters and folder. While the impression cylinders are printing, the web is stationary, but as soon as the cylinders have passed over the forme, the web is drawn forward the length of one sheet of the paper or the job being printed.

The Multipress. This press is similiarly built, with stationary beds; but the lower bed in this machine is not placed beneath the upper bed, thus, with the cylinder moved back, it is completely accessible from above.

The Hamm press possesses movable cylinders, whilst the *Hellman* has movable beds.

British Machines. The Lancashire press was described in the first edition of "Modern Printing."

In 1888, W. Hayward, of Highgate, took out a patent for a single-cylinder flat-bed web-fed printing, perfecting and folding machine on the Wharfedale principle, and in 1893 for a duplex flat-bed web or sheet-fed perfecting machine on the Napier and Wharfedale principles of topfeeding or underfeeding to the cylinders.

A press which is prominently on the market, and installed in a large number of offices, both at home and in the colonies, is that built by Payne & Sons, called the Cossar.

The Cossar Flat-bed Web Press. This press, which was first introduced in 1903, and has since been greatly developed and perfected, is a web machine printing from flat formes, with a reciprocating type bed of the ordinary Wharfedale movement. It is capable of printing, cutting, folding and delivering newspapers and magazines of 4, 6, 8, 10, 12, 14 or 16 pages, with all the pages inserted and cut at top and bottom, also with the half-sheets pasted in.

Two distinct types are built, the single-cylinder press and the two-cylinder press, each in a variety of sizes. Thus it can be adapted for a large number of classes of work.

With the special patented automatic registering gear, any number of previously printed webs can be associated with the one being printed, enabling the press to turn out papers of 8, 10, 12, 14 and 16 pages of 7, 8 or 9 columns to the page.

Being fitted with the maker's patented geared inking and

distributing apparatus, the machine has excellent inking power, which, with the substantial build and finish so long associated with Otley firms, ensures a firm impression. The table running on four rows of bowls makes the printing of half-tone blocks in newspapers quite a simple matter. It may here be stated that this class of work is being regularly produced on the press in question.

The machine is of simple construction, safe and easy to operate, and may be run by any machine minder of ordinary intelligence. Means have been provided to show clearly the proper height of the cylinder from the bed, thus enabling the minder to tell exactly the packing the cylinder requires, which also gives the proper peripheral speed to the cylinder, avoiding unnecessary wear to both type and blocks.

Another important point in this class of machine is that in the Cossar the formes are in full view of the minder and quite open for making alterations and corrections.

Built with simple and reliable cutting and folding arrangements, the machine delivers papers folded to quarter page and counted into any required number.

The single-cylinder press runs at a speed of 2,800 to 3,200 per hour.

The two-cylinder two-page wide press prints, folds and delivers counted 4-page papers at a running speed of 3,800 to 4,500 per hour.

The two-cylinder three-page wide press prints, folds and delivers counted a 4 or 6-page paper at a running speed of 3,600 to 4,000 per hour.

The two-cylinder four-page wide press prints, folds and delivers counted a 4, 6 or 8-page paper at a running speed of 3,200 to 3,600 per hour.

Each kind of machine with the addition of a reeling automatic and feeding device can produce a double number of pages in two operations, all pages being insetted and cut at top and bottom, folded to quarter-page size, and with half-sheets pasted in.

Each class is also constructed in different widths, except the four-page wide web, and this is built for 7 columns of 14 ems, maximum width per page. The illustration shows a two-cylinder press.

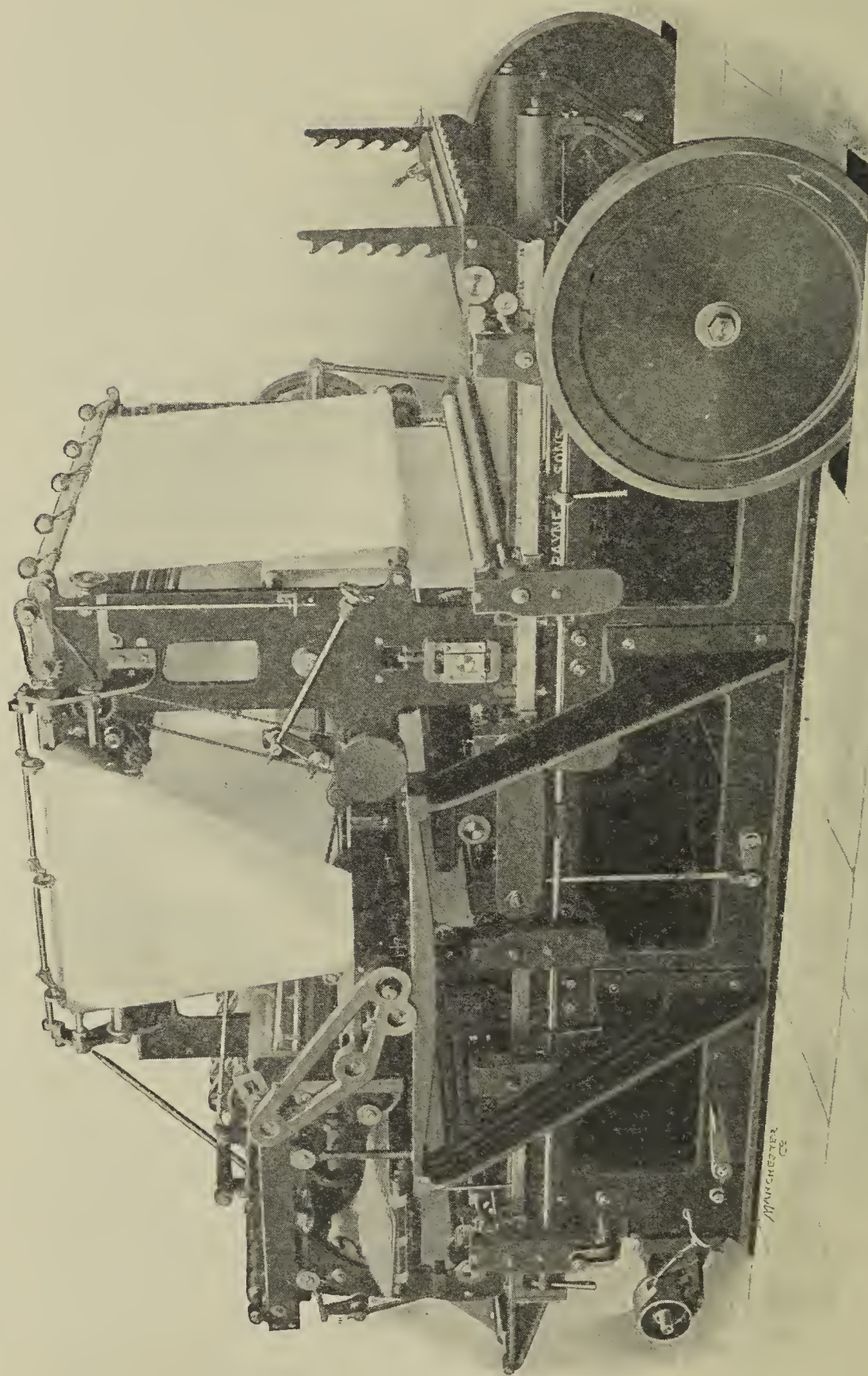


FIG. 38. THE COSSAR FLAT-BED WEB PRESS.

The Heureka Flat-bed Offset Newspaper Press. The Schwellpressenfabrik Actien Gesellschaft of Heidelberg, have in their Heureka press introduced the offset principle, and by this means they keep the web constantly running through the press.

At each end is placed a set of three cylinders ; one of each set takes the impression from the forme on a rubber surface. This impression is transferred to the second cylinder, producing a reverse impression, and is, from the second cylinder, transferred to the travelling web, the web then passes to the cylinder at the other end of the machine and is perfected, after which it is cut, folded and copies delivered. The impression cylinders revolve thrice to one travel of the table, one inking giving three impressions. This enables the web to keep running continuously.

Art Rotaries. The principle or unit of all rotaries having been fully described in the chapter dealing with rotaries, it is, therefore, only necessary here to touch on the special points demanded by this class.

Cylinders. These must be stiff enough to stand the heaviest of impressions. They must be very get-at-able—the plate cylinder not only for plating purposes, but also for brushing out or cleaning of the illustrations ; the impression cylinders on account of the amount of make-ready to be done.

Travel of Web or Sheets. All arrangements for the travel of the web or sheets must be carefully planned to avoid creasing, buckling, smearing, etc., and thus give a perfectly true run through.

Inking. On rotaries a far greater quantity of ink needs to be used to obtain the same depth of colour, than would be necessary on a Miehle or other flat-bed machine. Therefore, the best possible inking arrangements are an absolute necessity. The whole of the inking device should be made readily movable away from the plate cylinders, and yet be able to run up colour.

Set-off. The greater the speed the greater the set-off trouble, and effective means must be provided to cope with this.

Delivery. This is of far more importance than most

printers imagine, whether folded or in flat sheets. If the latter, there should be at least two delivery boards on which the sheets are delivered alternately ; the boards should also be balanced, to give or drop as the printed sheets accumulate.

Very little folding can be attempted if work is heavy, the best results being obtained by cutting into sections and then using parallel folds.

All-size Rotaries. The special points requiring consideration for this class are :—The range of sizes that can be reproduced ; the cutting arrangements and definite separation of sheets before reaching the grippers ; the alteration from one size to another should be simple and quickly done ; the alteration of plate-fixing arrangements should also be simple and easy ; folding mechanism must also be easily adjusted.

Colour Rotaries. By increase of half-units, i.e., plate cylinder, impression cylinder and inking attachment, any number of colours can be arranged for on either side or both sides of the web.

A number of special machines on the rotary principle have been built to print colours on either one or both sides of the paper.

CHAPTER XVI.

ROLLER CASTING.

It is of the very greatest importance that the printer should possess thoroughly good rollers, for without them he cannot produce respectable work.

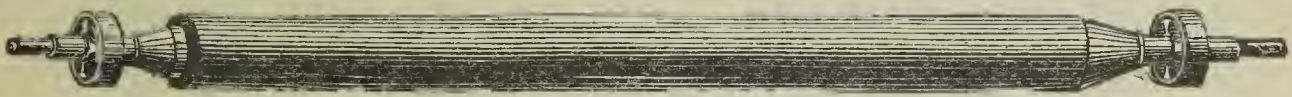


FIG. 39. MACHINE ROLLER.

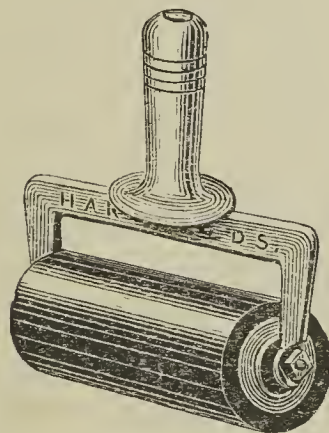


FIG. 40. SMALL HAND PRESS ROLLER.

Qualities of a good Roller. The following qualities should be possessed by a good roller :—

In shape it should be perfectly cylindrical, and exact in mechanical form from one end to the other.

It should never shrink or swell. Shrinking or swelling causes loss of time in setting the roller in the machine, and is always accompanied by a variation in the quality of the roller.

Its elasticity, if not absolutely perfect, must at least be good, so that it can adapt itself perfectly to the pressure of the forme.

It must have a sufficiently strong affinity for ink to take instantly a sufficient supply from the ink table.

It must part with its ink properly to the forme.

It should be able to withstand the action of proper detergents.

It should preserve these qualities under varying conditions of temperature, and of humidity in the atmosphere. Great improvements in this respect have been lately made, but when some kinds of composition are used summer rollers and winter rollers are necessary.

Mr. Earhart says in "The Colour Printer":—"A roller, when in the best condition for taking up the ink and freely giving it off again, should be firmly elastic, and should feel tacky when the hand is gently pressed upon its surface; at the same time, if the hand is moved rapidly along its surface it should feel smooth and polished, as if it was not very tacky. A forme roller should be nicely adjusted, so that it will be evenly pressed by the vibrator along its full length without flattening its surface; at the same time, it should firmly but evenly press the face of the forme without depositing any ink below the actual face of the type, cuts, etc., contained in the forme."

At the present time printers very seldom make their own roller composition, preferring to use special compositions produced by firms which devote themselves to this branch of manufacture. Nor, as a rule, do many printers make their own rollers. It is found advantageous to obtain them from firms which possess special apparatus for manufacture, and employ persons experienced in this kind of work.

Various roller compositions are supplied under special trade names, but they all belong to one of two kinds. In the older variety glue and treacle are the principal ingredients; in the newer, gelatine and glycerine. The latter are now in almost universal use.

In regard to the constituents, glue is hard when cold. To render it soft and springy fluid ingredients are used. Treacle, called molasses in America, is a syrup containing about a quarter of its weight of water in an ordinary temperature, and is adopted for admixture with the glue to keep it in a soft, elastic condition. Both the glue and treacle in a roller when kept in a dry place rapidly become hard. Constant

washings with water become necessary, but the unavoidable evaporation of the liquids also soon destroys the power of the glue to gelatinise. The composition then acquires a hard face, and if detergents, such as lye and water, are frequently applied it becomes cracked. The cracks not only cause the roller to give an imperfect coating of ink to the forme, but retain ink after the surface has been washed. A roller in this condition cannot be used for colour, such as red, after it has been used for black.

Glycerine, on the other hand, is a permanent liquid which, under ordinary circumstances, does not volatilise or lose bulk. With several admixtures it forms compounds which are insoluble in water, which is one of its chief advantages in roller-making. It may be deprived to a certain extent of its property of absorbing moisture, and rollers made from this modified substance will not swell or refuse to take ink when there is an excess of dampness in the atmosphere.

The old glue and treacle composition gave much trouble owing to its susceptibility to changes of the weather. It was generally necessary when such rollers were used to have several sets of rollers fit for working, some in hot weather, some in cold. The newer kind of rollers maintains a more equable consistency during all the seasons of the year. They also last much longer, and produce much better work. Although the first cost of the composition is higher, it is doubtful whether they are as expensive as the old kind when the losses in time connected with the use of the treacle-and-glue rollers are taken into account.

Another advantage of using the glycerine instead of treacle rollers is that the latter require far more care and experience in getting them into condition and maintaining them so. Modern conditions of printing demand that, as far as is practicable, rollers should be always in workable condition. A further advantage is that the newer kind of rollers lasts many times longer than the old one.

The following recipes for making roller composition have been found satisfactory, but much depends on the quality and purity of the ingredients used. Glue, gelatines, glycerine, and treacle are occasionally much adulterated, and sold in an unsuitable condition.

Recipe for treacle roller ;

Glue	...	...	...	...	9 parts by weight
Treacle	...	...	...	14	,, ,,
Paris white	...	...	...	1	,, ,,

Recipe for glycerine roller :

Glue	...	...	...	...	2 parts by weight
Refined sugar	...	...	...	10	,, ,,
Glycerine	...	...	...	12	,, ,,

The dry glue must, after being weighed out, be put in soak. A good way to soak glue is to put it into clean cold water for about twenty minutes, take it out and place it upon a board, covering it with a damp printer's blanket, and let it remain all night. In the morning it will be of the consistency of indiarubber, and will stretch like it.

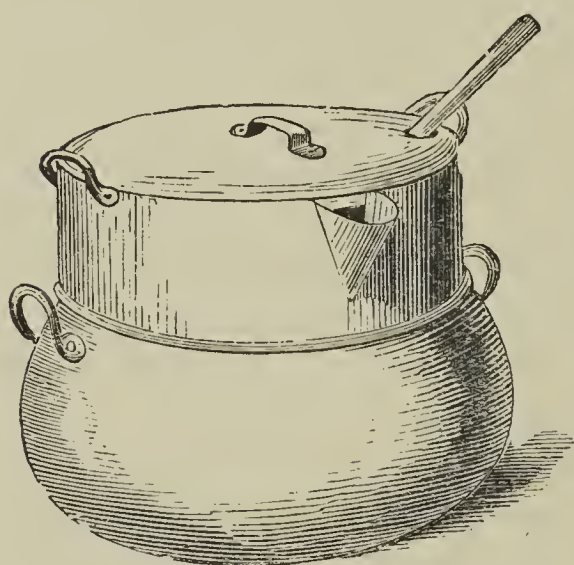


FIG. 41. MELTING KETTLE.



FIG. 42. MELTING KETTLE.

Put the kettle on and bring the water to all but boiling point, and keep it at that temperature. Then put the glue into the composition pot and stand the latter in the water. As the glue melts, keep it stirred till all traces of the water are out of it. Then add the glycerine, stirring it till it is well mixed with the glue. Next add the sugar, and keep the whole well stirred for from thirty to forty minutes. If it remains much longer it will probably "candy."

The appliances for roller casting, as used in ordinary printing offices, are a melting kettle and roller moulds.

The melting kettle, which should be provided with a stirrer, may hold from $2\frac{1}{2}$ to 10 gallons of melted composition. It may be heated by steam, or by gas, or a coal fire.

The moulds require to be most accurately bored and fitted. They should have vice-handle "dogs" and stout screws. Hand-press roller moulds are made of either cast-iron or stout brass. They range from 12 to 30 inches in length. Machine roller moulds are generally of cast-iron. They may be from 36 to 72 inches in length, and occasionally may be even longer.

Preparations before casting. The melting kettle is on the principle of the carpenter's glue pot, consisting virtually of two vessels, one within the other. They are separated by water, so that the inner one is not touched by the fire. A moist heat is desirable for reducing or liquefying the composition, to get it into a state fit for pouring. The material must be boiled, not baked. It must not be heated more nor longer than is absolutely necessary. Roller casting is a simple operation, if a little forethought is exercised.

Casting should always be done in a warm place. Before consigning it to the melting pot, the composition should be cut up into small pieces, somewhat about the size of a large jujube. This is done to facilitate thorough and quick melting.

If a small roller only is wanted, the composition may be cut up and put into a large jug, which may be placed in a metal pail of water and stood over a gas or other stove.

After the composition has been put in the kettle and whilst it is melting, the mould should be prepared. Care should be taken to see that it is perfectly free from rust or dirt. It should then be heated just hot enough to comfortably bear one's hand upon it. Carefully grease all over the inside with sperm oil, using as little as possible. The roller stock is then placed inside the mould. If an iron stock, it should be heated first. It should be painted with white lead, which must be allowed to dry, and a piece of coarse twine or tape wound round it. There will then be something for the composition to hold on to and keep there—otherwise it might come off the stock.

The mould should stand in an upright position when casting, and the composition poured over the roller spindle

so that it is filled from the centre and the oil is not washed from the sides. Have the composition only just fluid enough to pour it on the spindle. If it is poured too hot and too quickly air bubbles will probably make their appearance.

In pouring the composition into the mould, see that the spindle of the roller is exactly in the centre, so that there

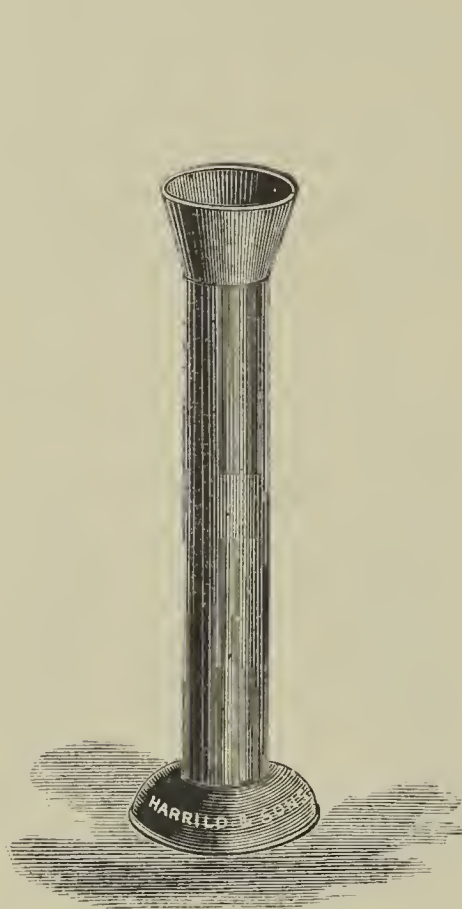


FIG 43. SOLID ROLLER MOULD.

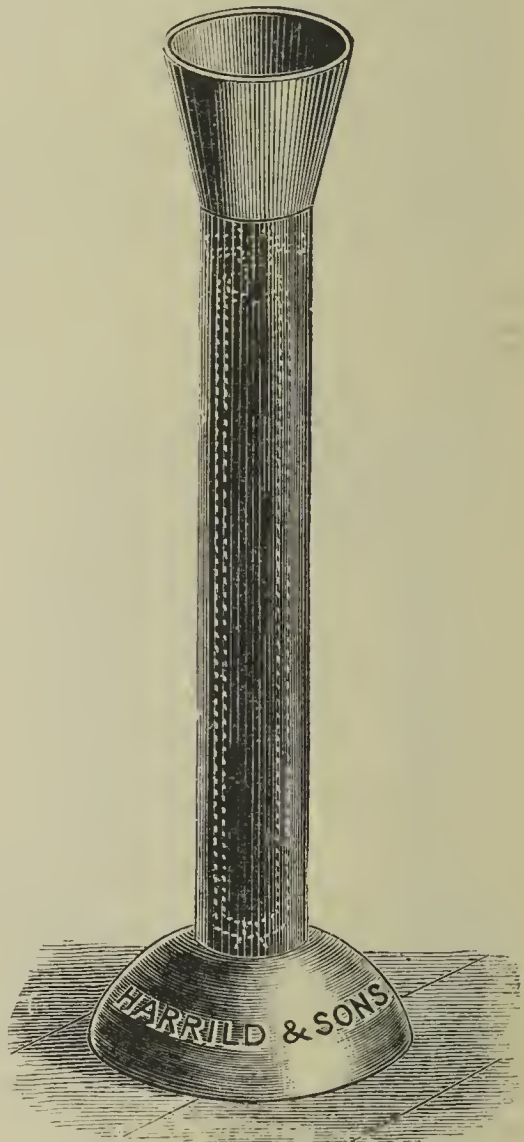


FIG. 44. SOLID ROLLER MOULD,
SHOWING POSITION OF ROLLER.

will then be an equal amount of composition all round the spindle. Pouring slowly prevents any holes and flaws. The mould is filled an inch or two higher than is required, to allow for shrinkage and trimming.

When the roller is cooled sufficiently, it is carefully removed from the mould and trimmed at the ends with a

sharp knife. After being kept from three to seven days it will be ready for use.

If the composition gets loose near the ends of the roller and it is in good condition elsewhere, a rough-and-ready remedy is to make a common table knife almost red hot,

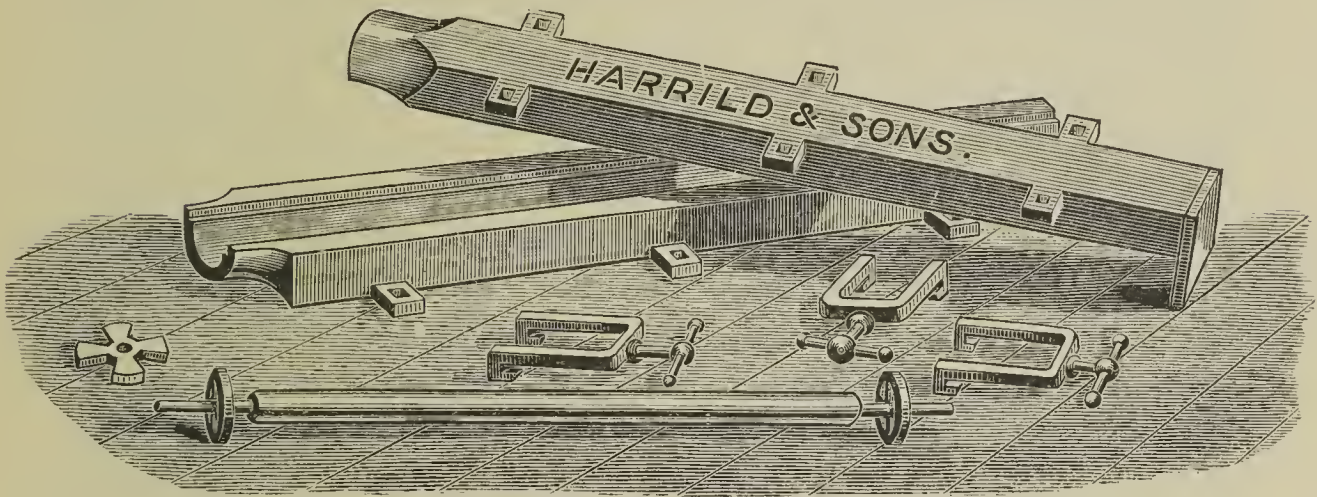


FIG. 45. ROLLER MOULD IN HALVES.

insert it on the side of the composition nearest the stock so as to make it sticky; withdraw the knife, and encircle the roller with the hands for a few minutes so as to exclude the air. If the adhesion is complete the roller will last for some time.

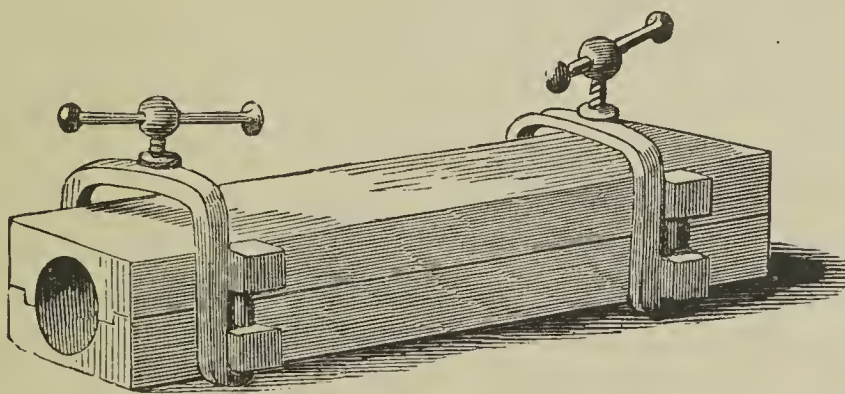


FIG. 46. ROLLER MOULD IN HALVES, CLOSED.

In drawing the roller from a tubular mould it is astonishing how it will stick sometimes. Many a roller has been spoilt in the drawing. No one who has not actually witnessed it could imagine the tenacity with which it sticks to the tube. The novice is sometimes disposed to facilitate the removal

by the application of hot water to the mould, but to do this would be to completely spoil the roller.

In order to obtain a perfect roller face three defects must be guarded against—pin holes, oil streaks, and chill streaks. To avoid pin holes, allow the composition after melting to stand quietly in the kettle till all the steam and air bubbles have time to ascend to the surface, and form a scum, leaving the melted composition beneath. This should be poured from the bottom of the melted composition, if possible, or, if that cannot be done, it should be well skimmed and then slowly poured. Pin holes not only interfere with the proper inking of the forme, but also render the roller difficult, or impossible, to clean when changing inks. Oil streaks are caused by putting too much oil in the mould. They are a serious defect. Every part of the mould must be oiled, but the oil must be used as thinly as possible. If any small part of the mould is missed in the oiling, the face of the roller at that part will be ruined, and the roller must be re-cast. Chill streaks are as bad as oil streaks, and are caused by cold moulds. The stream of melted composition coming in contact with the cold iron is chilled, and successive waves of composition do not unite. All moulds should be warm enough to prevent any chilling of the composition.

Defects in the faces of rollers not only interfere with the best printing, but they render the roller liable to tear off the stock, as the adhesion to the ink table is very considerable, and much power is exerted in the pull of the roller as it drags across the ink table.

Seasoning of Rollers. Immediately after a roller is cast, it is not ready for use. It must be seasoned. Seasoning is just as much a part of its manufacture as the casting of it. The object of seasoning is to obtain toughness and power of resistance to the pull of the adhesive ink table. The time required depends on the condition of the weather, the temperature, etc. When the air is saturated with moisture, it is useless to expect it to dry a roller thoroughly. The seasoning and general condition of the roller can be judged by its toughness when the end is pinched between the thumb and finger. If it is tough, it is in working condition; if it is soft, it is risky to use it. The cold dry days of winter are much

more trying than the driest summer days. The cold condenses the moisture of the air and removes it.

As soon as a roller is properly seasoned, it should be put into use.

When the new roller is drawn from the mould, the surplus composition should be trimmed from each end, and the roller put carefully away, keeping it out of contact with anything likely to dent or injure it.

Keeping Rollers in good condition. After having worked off the job, if in black ink, cover the rollers with a coating of thin ink. If in colours, carefully run the rollers over paper, cleaning off all the surface ink. Then run them with a free and full coating of thin lowering varnish, before putting them away in the roller cupboard. It will be necessary to clean off these coatings when working is resumed with the rollers, otherwise the printing will be deteriorated. The object of coating the rollers while not in working is to keep the atmosphere off from their surface. The coating also has the effect of keeping the consistency of the composition equal and level.

Some rollers when new are apt to pick up and distribute strong inks unevenly, and to work badly with stiff coloured ink. This is due to a patchy coating of oil which the roller receives from the mould in casting. The high temperature of the mould causes the oil to become partly oxidised, and as this coating comes between the ink and the roller, and robs the latter of its suction and affinity for the ink, it is necessary to remove it before the roller can be said to work perfectly. The best cure and one that least endangers the composition, is to place the roller or rollers in a machine working common ink. After a week or two of use on such work the fault of distributing unevenly will be found to have entirely disappeared.

Where time is an object, and the roller must be put into use at once, the following expedient will often remove the difficulty. The roller should be washed very carefully and quickly with a strong solution of ordinary washing soda, 1-lb. to the gallon, then sponged lightly and quickly with clean water and lastly with a sponge squeezed as nearly dry as possible. This operation is one that should only be resorted

to when pressure of time compels, any treatment including the use of water being injurious to the ingredients of glycerine rollers. After such washing the roller should be placed for as many hours as possible in a warm, draughty situation, such as the overhead portion of a staircase, where the heated atmosphere passing from one floor to the other causes a perceptible draught. Rollers may also be washed, with the same object in view, with a very weak solution of saccharine lye, and sponged very quickly and lightly with clean water; they should then be sponged dry and placed in a draughty situation.

The best and most useful forme rollers are those that are fit for working either coloured or black ink equally well. They ought to be able to retain their nature throughout long runs, and not after a few thousand runs get into a spongy condition, or become dry and leathery on the surface.

Inferior rollers, especially those made from old recipes or from cheap compositions, give much trouble. The job may be begun well, but after the machine is running a short time the work begins to look thick and cuts fill up. This is particularly the case when coloured inks are being used. The cause of the defect lies in the rollers having lost their power of suction. On washing them they will be found thick with ink. Such rollers should be got rid of, but if that is not possible they may be improved by pouring some glycerine into the palm of the hand and rubbing it well into the rollers. If they should be standing for any considerable time a coating of glycerine, with a little gentle hand-friction, may restore them. Good rollers will run all day, and at the end be as clean as when started.

To meet the annoyances caused by sudden changes of temperature, plenty of well-seasoned rollers should always be kept in readiness. This will save much time and trouble.

A roller is unfit for working if it becomes too hard or too soft, or if it possesses too much suction.

If a roller becomes cut it is unfit for use, as it will not properly ink the forme.

Leaving a roller for some hours on a flat surface will spoil the regularity of its cylindrical form.

Leaving ink which contains a quantity of driers upon the

face of a roller will often spoil it by causing a skin to form or by cracking it.

To render a "green" roller workable in an emergency it may be washed in turpentine. It may be further improved by rolling-up in common poster ink, which must be immediately washed off. Another temporary remedy is to rub powdered magnesia or alum over it with the palm of the hand, allowing the roller to stand for a time, then wiping off. Perhaps the best remedy is to place the roller in a current of warm dry air.

To restore suction and tackiness to a roller which has been rendered hard by age and use, a free use of glycerine is often most efficacious. Before leaving off work in the evening, after washing the roller, glycerine may be applied with the hand, rubbing thoroughly. The glycerine, amongst its other properties, possesses those of never drying and being very absorbent. On first beginning this treatment it will be found, after a few hours, that the rollers will again show a dry surface. As glycerine does not dry it has been absorbed, and the application should be repeated until, instead of being entirely absorbed, the glycerine has rendered the surface sufficiently moist to restore to the roller that adhesiveness which is an indication of its being again fit for work. After the rollers have been thus to a certain extent renewed, a slight application after each washing will renew their usefulness for a long time. Before using a glycerined roller of this kind, roll it over a piece of paper having a calendered surface, so that while any superfluous moisture is thus got rid of, no fluff of paper will adhere to it, which might be the case if soft, uncalendered paper were used.

The difficulties caused by the influence of the atmosphere on rollers are numerous and serious. The effect of hot weather on rollers is to make them soft and lifeless, the face to come away in small particles, clogging the type and covering the slab. Cold weather makes them hard on the face, unyielding, and takes away their tackiness.

In hot weather rollers should be kept, when not in use, in a cool, dry place, and when practicable a duplicate set should be in readiness, so that when one set is badly affected it may be exchanged for the other.

In cold weather rollers may be washed in benzoline or some equivalent, so as to soften to some extent their hard surface.

A lamp, taper, or a jet of gas with a flexible tube under the ink-table will assist in getting a roller into condition in cold weather.

Damp weather has often the worst effect of all upon rollers. They become "greasy" and refuse to take the ink. There is no permanent remedy for this except a change in the weather. Temporary relief may be obtained by rubbing the affected rollers with powdered magnesia or ground alum, applied with the palm of the hand. After being allowed to stand about an hour they should be rubbed down with clean waste, and may then probably work well for a day at least.

The Fraying of Distributors. The fraying at the end of these rollers is often a source of great annoyance and trouble. Several remedies have been put forward. Common yellow soap may be used instead of oil on the spindles, or blacklead will answer the purpose. Both of these articles are lubricators. The best remedy, however, is placing riders over the distributors.

Much trouble in "working up" stiff or coloured inks previous to working some jobs is due to the method of washing the ink slab. After being cleansed with paraffin the slab should be washed with potash and rubbed perfectly dry. This will enable the ink to fasten on the slab; it promotes the "pull" between roller and ink table, and enables the roller to retain its suction instead of becoming immediately coated with a thin greasy film of paraffin from the ink slab. This will often cause a roller to glide over the slab without pulling at any lumpy or streaky portion of the ink.

When trouble is experienced in working stiff inks a small piece of vaseline, the size of a pea, for each knifeful of ink will often remove the difficulty, provided the paper to be worked will allow of its use. With hard tub-sized writings the addition of greasy matter to ink requires great care and discrimination, otherwise, the paper being almost non-absorbent, the ink will give trouble in drying. With ordinary printings, art papers, and dull enamels the vaseline treatment often rectifies stiff ink, causing the rollers to take and

distribute the colour more freely. If used with discretion it will affect the drying of the work very slightly.

Washing Rollers. Rollers in which glycerine forms a part of their composition must not be washed with lye solution or benzine. Turps or spirit compositions must only be used.

Turpentine is best for cleaning glycerine rollers ; although dearer in price than benzoline it is cheaper in use. A rag soaked in turps will clean half-a-dozen rollers, but in using benzoline it is necessary to wet the rag continually, as the spirit evaporates so quickly when exposed to the air.

Carelessness in washing, by leaving water on the surface of a roller, will cause it to blister, and spoil alike the inking surface and the receptiveness to ink.

Although most of the preceding directions apply to all kinds of rollers, some of them apply only to home-made ones. The latter are given here for the benefit of those who are not able to obtain rollers from one of the many large firms which now make a special business of roller manufacture. It is most advantageous, as already mentioned, to use rollers produced in factories fitted up with modern machinery for roller making. Where this cannot be done, it is best to use one of the special compositions obtainable from the same firms. The makers of these compositions issue books of instruction for dealing with their particular products, and these instructions should invariably be followed.

CHAPTER XVII.

WASHING FORMES.

FOR many years printers were accustomed to wash all formes with lye. This is made from pearl ash—one pound to three quarts of water; or potash—one pound to five quarts of water.

The solvent action of these and other alkaline lyes can be considerably hastened by mixing a little quicklime with the lye before use, or by sprinkling the lime on the dried ink before making use of the lye.

After the forme is cleansed the solution of lye must be very carefully washed off with clean water.

When the forme is laid up, if the type is slippery it is a sign that the lye has not been properly washed off. Some men put a piece of alum in the corner of their case, and occasionally rubbing their fingers on it roughen the skin to prevent the type slipping through too easily. The use of alum is an evidence that formes are not thoroughly cleansed.

The objection to these lyes is, that while they make the type perfectly clean if the ink has not been allowed to harden too much on it, they warp wood letters and blocks. Various other detergents are therefore now used, amongst them turpentine, petroleum, benzoline, etc.

Of these materials turpentine (usually called turps) is, generally speaking, the most useful for formes containing wood as well as metal. Its chief drawback is its cost, but it is to some extent also objectionable from its inflammability, which is so great that it has to be used with much care.

Turpentine should, nevertheless, be avoided for type formes as much as possible. If not entirely removed it leaves a stickiness and greasiness which are very disagreeable when the type comes up for distribution. If allowed to harden in, nothing short of boiling or steaming the type will get it thoroughly clean.

When turpentine alone fails to remove very old and hard ink, carbolic acid added to it will prove efficacious. The acid divides the matter up into very small portions and liberates it from its holding point. Another material which may be used in conjunction with turpentine is Izal, which is not poisonous like carbolic acid.

Petroleum is usually but erroneously called in London paraffin oil. It is not quite so quick in its action as turpentine; it does not evaporate so quickly, and it does not leave quite such a clean surface after use. It is only about one-fifth of the ordinary price of turpentine, and does its work almost as well.

Petroleum is well suited for formes composed of wood and metal types. They should be gone over with a rag saturated with the oil, which should afterwards be removed with a clean rag. In this way the wood type will be perfectly cleaned of the ink, and the metal left almost as clean as type washed with lye. Wood types thus treated do not warp.

Liquids that evaporate quickly are very serviceable in washing over formes on the machine, and render unnecessary the delay of lifting the forme.

Benzoline and benzine (a thinner material) are extremely volatile. The objection to them is that they evaporate so quickly that they leave the dissolved ink on the face of the type in a hard form which eventually fills up the open spaces.

Another useful detergent is a yew tree wash sold at a very low price. It is for most purposes quite equal to turpentine.

Several proprietary articles are used for washing formes, and their merits are stated in the advertisements of the manufacturers. Some of them are more economical, and, perhaps, as equally effective as the chemicals named above.

Dirty type is a great annoyance to the compositor and a source of loss to the establishment. Few machine-room boys will wash a forme, chase and all, properly, unless someone stands by to watch them; and even then much waste of lye usually takes place.

It is a good plan to have a washing trough quite away from the rinsing sink, with a slanting board on which to place the formes, and a fixed receptacle in which to keep the lye-wash. The lye can then be used over and over again

without waste, and need only be thrown away when too dirty for use.

A separate brush should be kept at the rinsing trough, and care taken to well wash away all traces of the lye with clean water.

Wood letter should always be taken out of a forme and cleansed with turps, or some substitute for it, as the lye is very injurious to wood.

Rollers should be well sheeted with waste paper before washing. They will then come clean with half the expenditure of labour and material.

Lyes and detergents may in many cases be altogether dispensed with by subjecting the forme to the action of a jet of steam, which leaves the face of the type perfectly clean.

CHAPTER XVIII.

PRINTING INK.

PRINTING ink is composed of two elements—the colouring matter and the varnish, or boiled oil, which is the medium in which the colouring matter is contained. The quality of the product depends on the quality of the ingredients, the crushing of the solid matters used, and their judicious admixture. To manufacture a first-class ink requires not only good materials, but great experience, and a wide knowledge of chemistry.

Black ink is composed of varnish and lampblack. Linseed oil, etc., is most generally used for the finer grades of inks. It is first cooked by boiling, which eliminates the fatty principles and transforms it into a sort of gummy glue, colourless and transparent. Boilings of different lengths are employed so as to obtain varnishes of various drying powers, and more or less tacky. The fatty, bituminous, or resinous bodies intended to produce lampblack by their combustion are placed in clay furnaces. In each of these there is an appliance for collecting the soot produced, which constitutes the lampblack. It contains, however, fatty matters that must be extracted before it is made into ink. This result is obtained by calcination of the black for a considerable time. The varnish and the black are mixed by crushing and grinding, a process of great importance. It has for its object the finer division and reduction in size of the already impalpable particles of the lampblack, and the perfect amalgamation of the varnish with the black. According to the degree of fineness required in the ink the operation of grinding is prolonged.

Testing of Inks. Take a sheet of unsized paper and spread upon it with the finger a little of the ink. After a few hours the ink will be found to be surrounded by a sort of border of varnish. If the ink is of good quality the varnish will be

absolutely white or colourless. If it assumes a yellowish tinge the ink should be rejected, as it is not made of proper materials. Cheap inks, however, cannot be expected to show this purity.

Qualities of Ink. A good black ink should be a dense black—brilliant, oily, rather too thick than thin, and should dry rapidly. The finer an ink is, the greater its drying power.

Cheap inks cover much less surface than finer ones ; hence a low priced ink is not always the most economical.

Different classes of work require different inks. Three principal kinds of ink are manufactured—for news work, commercial or jobbing work, and book-work respectively. Inks for high-class illustrated work from electros, from wood engravings, and from process blocks, have already been dealt with.

A good ink will remain a permanent black, be easy of distribution and not liable to fill up the type. It is ready to attach itself to paper and detach itself from the type, and is slow to dry on type and rollers.

The most suitable ink to use for ordinary damped paper is one that is not too stiff, or it may give trouble by causing the paper to tear.

For super calendered paper an ink with more body and very fine in quality may be used. Sometimes a little bronze blue added to the black will help the drying and ensure perfect adhesion of the ink to the paper.

The quality of the paper to be used very largely determines the selection of the ink. For a good stout paper, worked dry, a fairly free-working ink may be used. If, as is usually the case in poster work, the paper is of an inferior quality, and damped, ink very much reduced would have to be used, to enable the grippers of the machine to bring away the sheet from the forme.

The same ink should not be used on a fast perfecting machine as on a hand press or platen. For the latter a gelatinous ink with good body gives the best result, except in the case of paper inclined to peel off. For a perfecting machine it is always an advantage to use ink of fairly good body, provided the paper does not tear. Should that difficulty

arise, the ink must be reduced in body, or an ink with less adhesive properties substituted.

Copyable Printing Inks are inks from which a copy can be taken in the ordinary letter copying book, by damping the copying sheet and applying pressure. These inks may be procured in a variety of colours—black, blue, red, magenta, mauve and violet.

Special rollers should be used for this kind of printing, and be kept apart from ordinary rollers. They should be cleaned with water only. Tepid soft water will keep them in condition for copyable printing for a considerable time.

Doubletone Inks—duo-tone, bi-tone, duple, are amongst other terms variously used by makers to represent a modern adaptation of coloured inks designed for printing illustrations. By means of some special treatment, a stained varnish for instance, such inks more or less successfully impart the effect of more than one colour or shade. In the best examples the secondary effect is clear and exceedingly effective and may be used with advantage more particularly with landscapes and seascapes showing atmospheric effects. Such inks have come widely into use for the better class of catalogue and magazine illustrations. There are drawbacks to the use of doubletone ink. One of them is that success depends so much on the grade and uniformity of the paper it is printed upon, some papers being much more receptive in respect to the varnish medium than others, and many supplies from the ink maker have been condemned by the printer through no fault of the former, but simply because the paper used by the latter did not closely correspond with that showing sample colours. As the secondary effect obtained from such inks is not developed until dry the pressman is apt to meet with difficulty in matching printed results. Owing to these and minor reasons doubletone printing has not proved popular amongst printers themselves.

CHAPTER XIX.

COLOUR PRINTING—SELECTION OF COLOURS.

A GREAT deal has been written on the science of colour which is of little practical use to the printer. What he really needs is a set of rules whereby he can know what combination of colours will give agreeable, attractive and harmonious results. The illuminators and miniaturists of the written books, which were the precursors of printed books, worked long before investigations were made into the principles of colour harmony and contrast, and in the choice of colour they evidently depended upon their own unaided sense of what was pleasing. As far as can be judged from the books which have come down to us, the result was usually in good taste. Some of the most successful modern printers trust in the same way entirely to their inherent colour faculty for guidance. They disregard theory and rely on their own experience. Their success must not be quoted as proving that theory is of no advantage. It is, however, quite possible to exaggerate the value of chromatic science to the printer. Persons with a defective appreciation of the effects of colour combinations seldom produce really good results even by carrying out the most elaborate rules. There is an immense number of conditions which have to be taken into consideration in applying these rules, and the variations which can be found in any one of the colours often render a rule quite impracticable. Still, some useful directions may be given which will at least prevent the inexperienced printer from falling into the more egregious mistakes. His best plan, even if he has mastered the principles given in the books, will be to experiment carefully before deciding on any combinations of which he has not had experience. If this is too much trouble, he may follow the results obtained by other printers before him. Happily specimens of the finest decorative work are now easily procurable, and these should be studied with the greatest care.

In order to render intelligible the information which follows, a few definitions will be necessary.

Colours have been divided into three classes :

1. The primary colours, yellow, red, blue. These are the original colours from which all others can be made.

2. The secondary colours are orange, green, and violet (sometimes called purple). They are of the second formation, each colour being produced by a mixture of two of the primary colours. Thus, orange is from red and yellow, green from yellow and blue, violet from blue and red.

3. The tertiary colours are russet, olive, citron. These are of the third formation, each colour being produced by a mixture of two of the secondary colours. Thus, russet from orange and violet, olive from violet and green, citron from green and orange.

A colour in its purest state, one which has not been changed by an admixture of white or black, is a *full* colour. The primaries, secondaries, and their various hues are full colours. A primary or secondary colour, slightly changed by the addition of a neighbouring colour, is called a *hue*. For example, a green-blue is a hue of blue, a blue-green is a hue of green. A *tint* is a very light or pale colour, produced by adding a small quantity of colour to a greater quantity of white. A *shade* is a dark or broken colour produced by the mixture of a full colour with grey or black. Such mixtures are sometimes called "sad" colours.

There are various distinctions made in regard to tones. A *half-tone* is a colour reduced to about one-half of its original strength by the addition of white. The *light tones* of a colour are the various degrees of colour produced by the mixture of a full colour with white. The *dark tones* of a colour are the various degrees of colour produced by the mixture of a full colour with black.

The tones of a colour range from the darkest shade to the full colour, and from that to the lightest tint. The gradation or range is called the "colour scale."

Colours in which red or yellow predominates are called "warm" colours; those in which blue predominates are called "cold" colours.

A colour is *complementary* to another when by a mixture

of the two, prismatically, white light is produced. This refers to prismatic colours, for it is impossible to obtain white by the mixture of complementary colours in printing inks or paints. A *spectral* colour is the tint which is seen upon a white surface after looking upon a coloured object for several minutes. The tint will in every case be exactly complementary

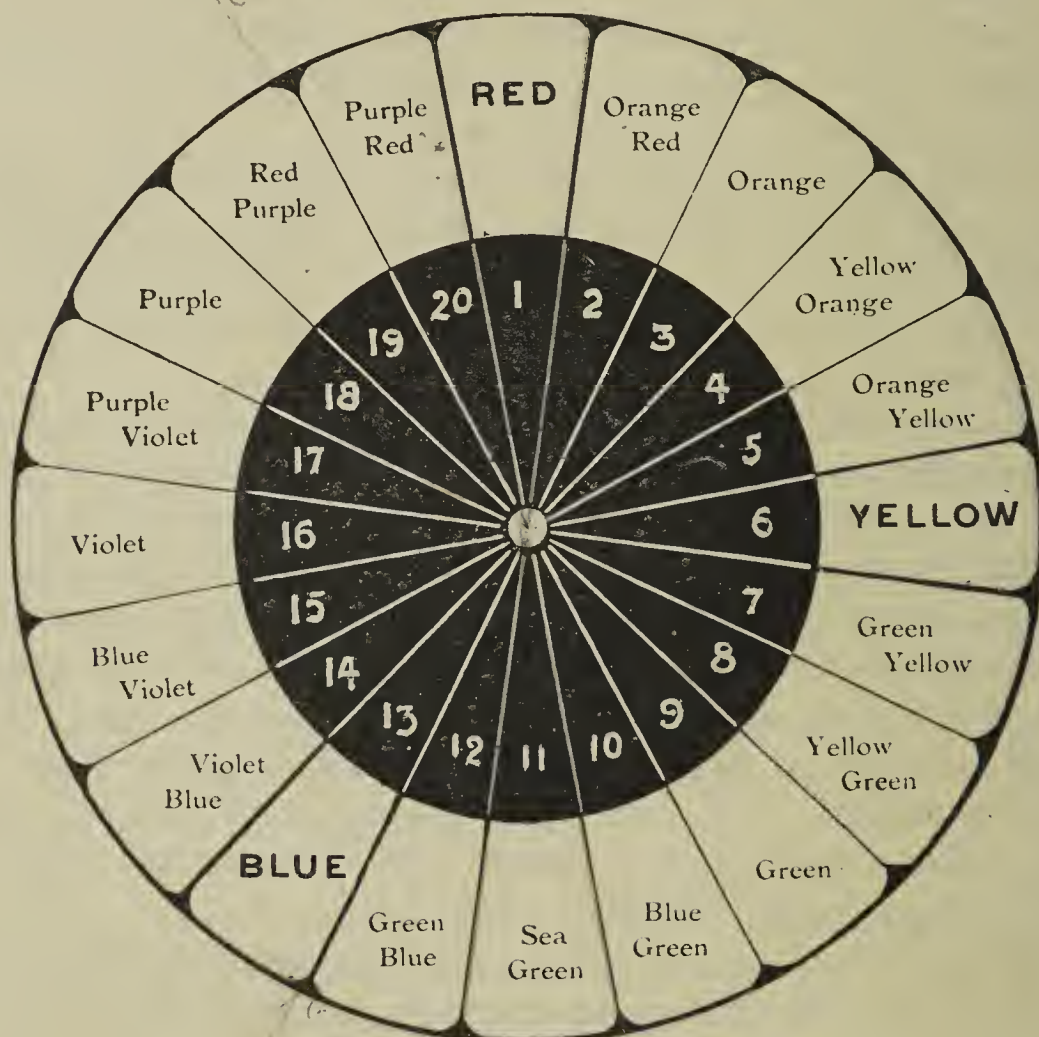


FIG. 47.

to the colour looked upon. The different colours produced by the refraction of the sunlight as it passes through a triangular piece of clear glass called a prism are called the *prismatic* colours.

Probably the most exhaustive work on the subject of colour printing is Mr. J. F. Earhart's "Colour Printer: a Treatise on the Use of Colours in Typographic Printing." This superseded every book on the subject previously issued, and forms a monument of intelligent and painstaking experiment, together with exactitude and lucidity of exposition.

In the book now before the reader nothing at all approaching to Mr. Earhart's voluminous instructions, accompanied by their examples, can possibly be attempted, and it would be presumptuous to try to emulate the achievement of one who is an acknowledged master of his art. We may, however, condense from his work a few conclusions which may be most serviceable to ordinary printers, while referring to the book itself for a statement of the considerations on which these conclusions are based.

Mr. Earhart forms a scale of colours in the form annexed. He, however, couples with the names actual examples of the colours, while we must indicate them by figures.

The chart is arranged so that the colours which are complementary are exactly opposite to each other. If the printer desires to get the strongest combination possible with any one of the colours shown, he must take the colour directly opposite to the one selected. If *red* (No. 1) be chosen, then its opposite (No. 11) *sea-green* will make its strongest combination.

Two-Colour Combinations. In the use of colours it must always be kept in mind that any colour occupying a small area of surface, when surrounded by another colour occupying a much larger surface, will be strongly tinted with the complement of the surrounding colours. For example :

<i>If surrounded by</i>	<i>The colour will be tinted with</i>
Red - - - - -	Sea-green
Orange - - - - -	Blue
Yellow - - - - -	Violet
Yellow-green - - - - -	Purple
Blue-green - - - - -	Red-purple
Sea-green - - - - -	Red
Blue - - - - -	Orange
Violet - - - - -	Yellow
Purple - - - - -	Yellow-green
Red-purple - - - - -	Blue-green

Very brilliant colours are influenced less by surrounding colours than the quiet ones. Grey is more affected than any other colour.

Red will harmonise with either of the two primaries, yellow or blue, and also with any one of the colours lying between

them in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Yellow will harmonise with either of the two primaries, blue or red, and also with any one of the colours lying between them in their normal state, or when reduced with white, or when slightly modified with grey. A very strong contrast exists between yellow, which is the lightest and most luminous colour in the chart, and violet, its complement. When combining yellow with any of the colours which lie between red and blue on the opposite side of the circle, it is not wise to make the contrast more violent by the addition of black to any one of these colours. A more pleasing combination will be obtained by the addition of white to the colour selected, thus reducing the violence of contrast. If, in view of the strong contrast between violet and yellow, the former be reduced with white to a half-tone colour the combination will be much more pleasing, because we then get not only harmony of colours but also a harmonious contrast of colours.

Blue will harmonise with either of the primaries, red or yellow, and also with any one of the colours lying between them in their normal state, or when reduced with white, or modified with grey, or darkened with black. Blue makes an effective combination with any one of the colours lying between red and yellow. Its best combination is orange.

Orange will harmonise with any one of the colours lying between green and violet, in their normal state, or when reduced with white, or when slightly modified with grey. Orange makes a good combination with any one of the colours lying between sea-green and blue-violet.

Green will harmonise with any one of the colours lying between violet and orange, in their normal state, or when reduced with white, or modified with grey, or darkened with black. The best combination with green is its complement, red-purple.

Purple will harmonise with any one of the colours lying between orange-yellow and sea-green, in their normal state, or when modified with grey, or darkened with black, or when the greens are reduced with white. The best combination with purple is its complement, yellow-green.

A General Rule. In two-colour combinations this rule can be safely followed. Any colour shown in the scale of complementary colours will form a good combination with any one of the seven colours on the opposite side of the circle, in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Combination of Tones. To obtain the best result in the combination of two tones of one colour, or two tones of different colours, always combine a full colour with a dark tone, or a full colour with a half-tone, or a half-tone with a very light tone. By following this rule a violent contrast of tone will be avoided.

Combination of Hues. In combining two hues a primary colour should show plainly in each hue. For example, when a hue of blue and a hue of green are combined the blue should be moved towards violet and the green towards yellow, that is, in opposite directions on the chart. This would make a combination of violet-blue and yellow-green. The best results will be obtained if a different primary colour predominates in each hue.

In nearly all of the best two-colour combinations it will be found that they are really complementary colours, somewhat modified by the addition of other colours or black.

The combination of colours which are complementary, while not always the most pleasing, is sure to produce the strongest contrast. For bold and effective work the combination of complementary colours cannot be excelled. By the combination of two colours which are complementary each colour gains in fulness, whilst the combination of two colours which are not complementary will cause each colour to move a little towards the complement of the other.

The combination of cold and warm colours always results in the warm colours appearing warmer and the cold ones colder.

All of the primary colours are increased in strength and fulness when combined with white on a grey ground.

When there is a lack of harmony or contrast between any two colours they should be separated by a band of black, white, gold, or some neutral colour which will harmonise with both.

A very effective two-colour combination is obtained by

combining a primary or secondary colour with its complementary grey, that is, a grey to which its complement has been added.

Black will form a good combination with any colour lying between red and blue on the right side of the circle. The light tones of blue should be used in combination with black, otherwise the contrast will be weak. Black forms its best combination with orange-red or vermilion. A common mistake with printers generally is the combining of a purple-red or rose-lake with black. Purple-red or rose-lake will combine well with black only after the black has been moved towards green by the addition of green or yellow.

Grey will form good combinations with any of the colours shown in the circle, especially those lying between red and green; its best combinations being yellow and the light tones of red, orange, and green.

Combinations of Three or more Colours. In many of the best three-colour combinations it will be found that they are really combinations of the primary colours in a modified form; that is, red predominates in one colour, yellow in another, and blue in the other. For example, the red may be modified with grey, or shaded with black, or moved towards orange or purple; the yellow may be modified with grey, or shaded with black, or moved towards orange or green. The blue may be modified with grey, or shaded with black, or moved towards green or purple. In the combination of the three primary colours modified they should always be moved in the same direction around the circle. That is, if the red be moved towards purple, then the yellow must be moved the same distance towards orange, and the blue the same distance towards green. If the red be moved towards orange, then the yellow must be moved the same distance towards green, and the blue the same distance towards violet. This rule will also apply to any combination of three colours shown in the diagram of complementary colours.

Red will harmonise with the other two primaries, yellow and blue; also with

Yellow and green-blue,
Yellow and violet-blue,
Green-yellow and blue,

Green-yellow and violet-blue,
Yellow-green and violet-blue.

If the red be moved a little towards purple, or a little towards orange, then the other colours in the combination must be moved an equal distance in the same direction around the circle, so that they will be at the same relative distance from each other as before the change in the red. Any of the pairs of colours named will form a good combination with red, in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Yellow will harmonise with the primaries, red and blue; also with

Purple-red and blue,	Purple-red and green blue,
Orange-red and blue,	Red-purple and sea-green.
Orange-red and violet-blue,	

Any of the pairs of colours named will form a good combination with yellow, in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Blue will harmonise with the primaries, yellow and red; also with

Yellow and purple-red,	Green-yellow and purple-red,
Yellow and orange-red,	Green-yellow and orange-red.
Green-yellow and red,	

Any of the pairs named will form a good combination with blue, in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Orange will harmonise with

Green and violet,	Blue-green and purple-violet,
Green and purple-violet,	Sea-green and purple-violet,
Blue-green and violet,	Sea-green and purple,

in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Green will harmonise with

Violet and orange,	Blue-violet and orange-red,
Violet and orange-red,	Purple-violet and orange,

in their normal state, or when reduced with white, or modified with grey, or darkened with black.

Purple will harmonise with

Orange and blue-green,	Yellow-orange and sea-green,
Orange and sea-green,	Orange-yellow and sea-green,
Yellow-orange and blue-green,	

in their normal state, or when reduced with white, or modified with grey, or darkened with black.

In three-colour combinations this rule may be safely followed. Any three colours shown in the scale of complementary colours will form a good combination when they are selected as far from one another as possible. There should be at least four colours between any two colours on the *warm* side of the scale, and at least five colours between any two colours on the *cold* side of the scale.

For example, in the combination red, yellow, and blue there are four colours between red and yellow, six colours between yellow and blue, and seven colours between blue and red. In the combination purple-red, green-yellow, and violet-blue there are six colours between purple-red and green-yellow, six colours between green-yellow and violet-blue, and five colours between violet-blue and purple-red.

Combinations with Black. Black should be combined with a cold colour only after the latter has been reduced with white.

The following is a list of good three-colour combinations, including black :—

Black, red, and yellow.

Black, red, and green-yellow.

Black, red, and yellow-green.

Black, red, and the light tones of green, blue-green, sea-green, green-blue, and blue.

Black, orange-red, and green-yellow.

Black, orange-red, and yellow-green.

Black, orange-red, and the light tones of green, blue-green, sea-green, green-blue, and green.

Black, orange, and yellow-green.

Black, orange, and the light tones of green, blue-green, sea-green, green-blue, blue, and violet-blue.

Black, yellow-orange, and the light tones of blue-green, sea-green, green-blue, blue, violet-blue, and blue-violet.

Black, orange-yellow, and the light tones of sea-green, green-blue, blue, violet-blue, blue-violet, and violet.

Black, yellow, and the light tones of green-blue, blue, violet-blue, blue-violet, violet, and purple-violet.

Black, green-yellow, and the light tones of blue, violet-blue, blue-violet, violet, purple-violet, and purple.

Black, yellow-green, and the light tones of violet-blue, blue-violet, violet, purple-violet, purple, red-purple, and purple-red.

Black, red, and green-grey.

Black, red, and blue-grey.

Black, orange-red, and green-grey.
 Black, orange-red, and blue-grey.
 Black, light green, and purple-grey.
 Black, light green, and red-grey.
 Black, light blue, and yellow-grey.

Combinations with Grey. Grey will form a good combination with any two colours which are complementary to one another, or nearly so. It is the happy medium between black and white. Any colour seen upon a black ground will appear paler; when seen upon a white ground it will appear deeper; but when seen upon a grey ground it will appear at its true value.

In forming combinations of three different colours it is generally most effective to combine

A full colour, a half-tone, and a tint,	}	or	{	a deep shade, a full colour, and a half-tone.
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The reason is that in such combinations we have moderation in contrast as well as harmony of colours.

CHAPTER XX.

MODIFICATION OF COLOURS BY PROXIMITY.

IT is important in colour printing to notice the effect which one colour has in modifying another when the two are in close proximity to each other.

The primary colours, as already pointed out, are red, blue, and yellow. The complementary of yellow is purple; the complementary of red is green; the complementary of blue is orange. When red is in immediate contrast with any other colour it imparts to that colour a greenish tone; when green is in contrast with any other colour it imparts to that colour a reddish hue; when purple is contrasted with any other colour it imparts to that colour a yellow tone: blue imparts an orange tone; and orange a bluish tone.

In colour printing the effect of this law of contrast is not always marked. In some few cases it is scarcely perceptible, whilst in others it is clearly seen. No doubt, it has often occasioned many perplexing problems to those who are ignorant of its working when engaged in matching colours.

Mr. Harwood illustrates this point as follows:—If we were to take a solid block two or three inches square, and then take a border a pica or two wide, we could easily test this law of contrast. Thus, if we pull the solid block in pale grey and the border in black, the effect is to make the grey appear paler. The effect on the black is not visible, although doubtless it exists. But in the other cases, where deep green is contrasted with pale green, and carmine with pink, the increased force is distinctly obvious, and this is one reason why it is correct in printing to place a deeper tone upon a pale tone of the same colour. It is, therefore, right to print deep blue on pale blue, deep green on pale green, carmine on pink, and so on.

If we were to take the blocks again and pull the solid in pale green and the border in deep green, or the solid in pale blue and the border in deep blue, we should see that the pale

tints enclosed in the border become paler, and the dark colours appear darker, than impressions of the border alone. In the use of colours, we must always bear in mind the fact that any colour occupying a small area of surface, when surrounded by another colour which occupies a much larger surface, will be strongly tinted with the complement of the surrounding colour.

Very brilliant colours are influenced less by surrounding colours than the quieter ones, grey being affected more than any other colour. In the case where pale pink is contrasted with deep yellow the effect is very remarkable, the complementary of the yellow making the pink appear thoroughly purple in tone.

It is obvious that some knowledge of the law of contrast and its effects should form a part of the education of every intelligent jobbing printer. By the aid of this knowledge many things, otherwise obscure and mysterious, become clear and intelligible.

Coloured Papers and Cards. The value of a knowledge of these principles of chromatics is shown when these are applied to printing on coloured surfaces. Even in ordinary commercial work the printer is frequently called upon to print a circular or card upon a tinted ground in one or two colours, and from the absence of a special training or a ready means of reference, is often in doubt as to which colours would be appropriate. In dealing with tinted grounds, when the printing is in one colour only it is always safe to use a deeper tone of the colour of the ground. But the object should be to make the colour of the ink used for printing on a tinted ground to blend with it, so as to offer no abrupt contrast to the eye.

In dealing with yellow or buff papers, it is right to use rich browns, maroons, or chocolate, always bearing in mind that the tone of brown chosen should be of a similar tone to that of the ground. On yellow tints, purple may generally be used. On pale buff, ultramarine blue may also be used. Upon blue tints, deep blue, carmine, or purple should be used.

Very helpful to printers who do much printing on coloured papers and cards, and who wish to produce the best effects with the least expenditure of time in study and experiment, will be found "The Harmonizer," also by Mr. J. F. Earhart.

It consists of a number of leaves of paper of different colours. On each of these leaves is printed a job in one, two, or more kinds of coloured ink. A table is given whereby other combinations can be made. The author first selected the different tints of paper, and then selected the following twelve colours :—

1. red.	5. green.	9. deep blue.
2. yellow.	6. violet.	10. white.
3. blue.	7. rose lake.	11. grey.
4. orange.	8. lemon yellow.	12. black.

From these twelve originals were produced twenty-four mixed colours, thus :

13. - 1 of 1	21. - 6 of 4	29. - 5 of 7
2 ,, 4	1 ,, 6	1 ,, 12
14. - 3 ,, 1	22. - 15 ,, 4	30. - 1 ,, 8
1 ,, 12	1 ,, 9	4 ,, 11
15. - 15 ,, 1	23. - 5 ,, 4	31. - 1 ,, 1
1 ,, 12	1 ,, 12	3 ,, 10
16. - 30 ,, 2	24. - 20 ,, 4	32. - 1 ,, 3
1 ,, 5	1 ,, 12	4 ,, 10
17. - 10 ,, 2	25. - 1 ,, 5	33. - 1 ,, 4
1 ,, 6	1 ,, 9	3 ,, 10
18. - 3 ,, 2	26. - 1 ,, 5	34. - 1 ,, 6
1 ,, 12	5 ,, 8	4 ,, 10
19. - 20 ,, 2	27. - 3 ,, 9	35. - 1 ,, 7
1 ,, 12	1 ,, 12	4 ,, 10
20. - 1 ,, 3	28. - 1 ,, 7	36. - 1 ,, 5
4 ,, 11	20 ,, 11	1 ,, 9
		10 ,, 10

The printer who experiments with these formulæ will find that he possesses two dozen attractive colours for use on white paper. It should be remembered that the shade resulting from the combination of two or more colours will vary according to the staining value of the pigments chosen. If, for example, a given quantity of blue be divided into two equal parts and these be respectively mixed with equal quantities of chrome yellow and aniline yellow, the two resulting greens will be very different in shade. In "The Harmonizer" he can see at a glance how they will appear on coloured papers, as well as further combinations.

Mr. Earhart also gives the following directions to those

having some knowledge of the harmony of colours, for use in making a selection of coloured inks to be printed on coloured papers :—

1. It is safe to use inks which bear a close relation in colour to the tint of the paper selected, provided there is enough difference in depth of colour between inks and paper to produce an agreeable contrast.

2. It is safe to use inks which are complementary to the colour of the paper, that is, colours which are not related, and are, therefore, as far removed as possible from the colour of the paper.

3. It is safe to use one or more inks which are related to the tint of the paper in combination with one or more inks which are complementary to the tint of the paper.

It is well to be careful in the use of inks which are neither related nor complementary to the colour of paper selected. As a rule, these combinations will not be in harmony unless the paper inclines to a neutral tint.

CHAPTER XXI.

PROPERTIES OF INKS USED IN COLOUR PRINTING.

THE art of colour printing is totally different from that of ordinary black letterpress, in so far as the colour printer has to deal with a variety of circumstances unknown to his brother, the printer in black.

The colours formerly used for printing were, with a few exceptions, entirely of a mineral nature—that is, they were prepared from mineral substances. Thus we had dull reds in the familiar ochres and oxides of iron, and the more brilliant red, known as vermilion, a compound of mercury and sulphur. Carmine, prepared by precipitating the colouring matter obtained from an insect (*coccus*) by means of alumina and ammonia, was used to a certain extent to brighten dull reds, and resist fairly successfully the bleaching action of light. In the preparation of ink for the printing of these two latter colours, vermilion and carmine, if the same course were pursued in both cases, the resulting material, in the one case, would be utterly useless, seeing that vermilion, being a heavy mineral substance, weighs a great deal more than carmine. It is quite evident, then, that the amount of varnish which will suffice to produce a good red ink from vermilion will be inadequate for the requirements of a carmine ink.

Vermilion. The chief difficulty which the printer has in connection with vermilion ink is that, if printed from ordinary types, the colouring matter becomes in part decomposed by contact with the lead, and a darker colouring matter is formed with the sulphur, which is one of the ingredients of vermilion. Thus it is necessary that the types, if made of lead, should be coated with a harder material.

Blue is another colour found in a variety of forms, many of which might be, but few are, available as a colouring material for the printer. Thus we have ultramarine, which

used to be obtained from the somewhat rare mineral called lapis lazuli, but which is now prepared by heating white clay with salts of iron and soda ; Prussian blue, obtained by heating woollen rags or hoofs of cattle with potash and iron, precipitating the solution so obtained with salts of iron ; smaltz, which is merely blue cobalt glass, ground in fine powder.

Light Blue or ultramarine ink is always unsatisfactory and difficult to get good work from, the impressions generally being rough and mottled. It should be remembered too, that, like vermilion, this colour should be printed from face-hardened blocks and type. To get good work from ultramarine ink takes a clever colour printer all his time. He may, however, improve its working properties by the addition of a colour commercially known as Imitation Cobalt. Ultramarine blue is quite a fast colour in ordinary senses of the word, but when such printing is exposed to the action of acid vapours, it rapidly loses its colour and becomes bleached.

Dark Blue Ink, or that made from Prussian blue, is in most senses a satisfactory ink to work, the impression being dark and clear, and the colour always grateful to the eye. There are numerous shades of this class of blue colour, from the purest light blue to the deep blue-black or China blue. Most varieties of ink made from this colour impart a bronze sheen or bloom to the printing. This sheen is metallic or coppery in effect and is a favourite with printers and the public. There are seldom complaints of the working of this coloured ink, as it does not deposit on the type, rollers, or table. Unlike ultramarine ink, the ink made from Prussian blue withstands the action of acids, but when exposed to alkaline fumes, such as ammonia, it becomes rapidly bleached, and loses its colour. A special alkali-proof dark blue, very similar to the ordinary Prussian blue is, however, obtainable for use on paper or fabrics that may have to come in contact with alkali.

As this ink is now frequently used for imparting a rich bloom to fine black printing ink, it should always be held in mind that this colour is liable to deterioration in the manner indicated. Although a temporary good effect may be produced by its use, black work exposed to such influences as

those referred to, will, after a time, probably deteriorate in quality.

Smaltz or Cobalt Blue is used in some rare instances, such as for printing bank cheques and notes. This colour, being unaffected by either acids or alkalies, of course holds a high place where permanence is a desideratum. The printing from this ink is very transparent, and it may consequently be used with advantage in printing in blue skies.

Indigo is very seldom used. It makes a good tinting material with varnish and transparent whites, and is sometimes used with transparent yellows for foliage greens.

Green. The number of pigments available for printing ink are few, but the variety of shades is great, from the most intense vivid and brilliant green of the emerald, to sap or deep green. These greens are generally composed of Prussian or some similar blue and chrome yellow, which is a compound of chromium and lead. As a rule, inks made from these colours are fairly good in working qualities, and give little or no trouble to the colour printer. Of course, owing to the blue colours which form such an important constituent of their composition being subject to bleaching and destruction under the influence of alkaline substances, the chief objection to the use of these greens in decorative work is that already referred to—namely, change or loss of brilliancy on exposure. Oxide of chromium is a permanent green, but being weak in colour value is more useful when mixed with other greens than when printed by itself.

Yellow. The principal form of this colour, made for decorative work, is that of trioxide of chromium mixed with oxide of lead or chrome yellow. This, mixed with clear varnish, yields a good working ink which has few drawbacks. Such inks, however, are opaque, and where transparent tints are required, organic yellows, prepared from quercitron bark and other yellow dye woods are employed.

It will be seen that if a tint is required, in which the body or bottom colour has to show up through the super-imposed layer, this latter must be transparent.

Browns. A great variety of brown colours exist in nature. These consist of the coarser forms of oxide of iron—ochre, umber, sienna and the like—whereas the finest browns used

in printing are made from red lakes, toned with blue, yellow and black to the required shade. As a rule these inks work well, and the ochre, umber, and sienna inks need no dryers, as they themselves act as dryers to the varnish.

Tones of Colours. All colours are reducible into *tones* by means of either black or white. Thus we have the colours of the spectrum when mixed with varying proportions of black and white giving a whole series of graduated tints, all of a lighter or darker quality. Chevreul (Principles of Harmony and Contrast of Colours) places upon a circular plane seventy-two distinct colours, which he calls a "gamut." Each "gamut" comprises twenty tints of the same colour, the intensity of which increases from the centre, which is white, to the circumference, outside of which is supposed to be black.

By continuing this operation of reducing pure colours with black and white respectively, it is evident innumerable hues and tones may be obtained—of course care being taken that the mixed colours are not put together in the proportions they occupy in the spectrum, which would cause the destruction of colour, and the reproduction of white light. The number of such tints which have already been obtained amounts to nearly 15,000. Of course, such combinations require a lifetime of skill and patience, and the question of contrast becomes one of very great difficulty indeed. By studying Chevreul's laws, as laid down in his method of nomenclature, the colour printer will obtain an insight into this important and interesting question.

Juxtaposition of Colours. Another matter of great importance in colour decoration is the nearness of one colour to another. If a mass of red and a mass of blue are placed side by side, the two colours are distinctly seen without admixture. If, however, the mass be represented by intermingled lines of colour alternating the one with the other, the juxtaposition of the two gives the same effect upon the eye as if the colours had been rubbed together in varnish, and a purple ink produced. The latter fact should be well borne in mind where an intricate number of colours is intermingled, seeing that it is quite possible to combine two colours, which in mass would be exalted by the proximity of

one with the other ; whereas, when broken up and forced into juxtaposition, they would produce a displeasing effect.

As a glance at the specimen book of any ink manufacturer will show, a great number of shades of colour are now employed for the manufacture of printing ink. Those already referred to were at the disposal of printers of former days. Within recent years a new class of colours have sprung into existence. These are the colours produced from coal tar. From this foul-smelling body chemical skill has arrested, or almost created, a vast array of beautiful and useful products. Some of them are of marvellous brilliance. The advent of these colours, generally known by the name of aniline, has produced a great change in colour printing. Gorgeous posters of rainbow hue have taken the place of the more sober and sombre wall bills of olden days. The drawback to some of them is their inability to resist bright sunlight, but this deficiency is being gradually overcome, and every year adds several new fast pigments to the range available for the printing ink manufacturer.

We may add that much of the excellence shown in the colour work of some printers depends upon cleanliness. Unless good rollers, thoroughly washed, are used, brilliance of colour is unattainable. Even when the best inks are used, an inferior effect is to be expected if ink tables, and everything which comes in contact with the inks, are not scrupulously cleaned. A few grains of black ink will change a fine ultramarine blue to a dark blue, scarcely fit for poster work. The delicate and costly carmines are utterly spoilt by contamination with black, or any of the stronger colours. So also with the lighter shades of aniline colours.

It is advisable to have at least two sets of rollers. The disc or distributing cylinders should be washed over several times. If the rollers are cracked, they should be very carefully cleansed with a brush ; but such rollers should never be used for colour work. It is a good plan to put the colour on, to make ready the forme, to pull twenty impressions on spoiled paper, and then to wash up again in a thorough manner. The secret of purity and brilliancy of colour is absolute cleanliness of the ink duct, table, and rollers.

CHAPTER XXII.

COMPOSING AND MAKING READY FOR COLOUR PRINTING.

A NUMBER of inventions have been tested, which have had for their object the printing of several colours simultaneously. The main idea of most of these has been to coat the inking rollers with the colours in such a way that the portion of the forme intended to receive them shall only be inked with any particular colour, and the other parts shall have, also, their proper colours. Some of these inventions have been found useful for special kinds of work; but as a general statement it is true that up to the present the only really practicable plan is to print one colour at one time, which involves the running of the sheet of paper through the machine as many times as there are changes of colour.

Three methods are available. The job may be set up in the usual way, and proved. As many stereo plates of it are then cast as there are to be workings in different colours. All the lines in each block are then cut out which are not to appear in the same colour; all the lines except those to be in black, from one plate; all except those which are to be red from another, and so on. In many instances this is the most economical procedure. It also ensures the perfect register of the successive colours.

The next plan, which we do not recommend, is to set up the forme and print only from the selected lines by raising them up from the adjoining lines so that the latter shall escape the inking roller and the impression. The complete forme is known as the key forme. A number of proofs is taken from it. One of these proofs is pasted on the back to form a guide for the next operation. That is to paste on the back of each line a strip of cardboard—about “ten-sheet” in thickness will be sufficient—and to drop the forme. The cardboard underlays will force the lines to which they are attached upwards, and their surface will be higher than that of the rest of the

forme. The other parts of the forme, intended to be printed in other colours, may be treated in the same way. This plan is available only on the hand press and on the platen machine. One drawback is that the parts which are sunk may be drawn up by the rollers and "black." This may be obviated in the case of the press by using a frisket. On the machine the same end may be gained by pasting a sheet of paper on the gripper fingers and stretching over the job. Spaces for the lines to be printed may then be cut out.

The third plan, which is that most commonly adopted, is known as "dissecting" the forme. The latter is set up as usual and several proofs are pulled. On one are marked the lines to be in black, on another those to be in red, etc. The lines to be printed first are left in the chase, while those to be printed next are lifted out. The spaces thus left have to be filled up, which may be done with lines of quadrats, metal furniture, leads, etc.—quadrats being preferable. The most systematic way is to place the first line that is lifted out on a galley, then to calculate the exact space between it and the next line that will have to be lifted, and to put that amount of space on the galley. The next line can then be removed from the forme, and the process continued.

It is obvious that it will much assist in this dissecting process if the lines for various colours are kept, in setting the forme, at distances measured in equal points. It is then a matter of calculation, instead of measurement, to adjust the space to be filled up to compensate for the lines that are left out.

Selection of Type. Founts that are much condensed should not, as a rule, be used for colour work as they become almost illegible. Nor should those be used which have a light face, or those which are shaded. The shading in the type makes some colours grey. The best types are those which are bold and strong and which have no fine serifs, such as the Jenson series in romans, the De Vinne and Bradley, and other faces which have a comparatively large surface for receiving ink. Lines that would appear too heavy in black may be used, as the colour will tone them down and render them less conspicuous. For printing in colours or gold rather heavy or thick faced rules are required.

A ready method for ascertaining the general effect of a job which is ultimately to be worked in two or three colours before actually making up the skeleton formes, is as follows: take out the lines to be in colours from the key forme; justify it, and pull in its proper colour on a sheet of its own paper. Tie up together all the lines to be worked in the second colour and pull them in their proper colour. Do the same with the others. Then paste down the lines in their places on the proof from the key forme.

A proper proof should be obtained from the key forme before dissecting it, in order that any necessary alteration in spacing, etc., may be made.

It may be convenient here to enumerate, in consecutive order, the operations of printing a job, such as a quarto circular, on a platen machine.

1. The proof sheets are pulled of the key forme, as already mentioned, for obtaining register in the skeleton formes.
2. The rollers, ink duct, and table are carefully washed up, and any paper or dirt adhering to type bed or platen removed.
3. The whole of the impression is taken off.
4. The platen is packed or clothed. Three sheets of, say, 34-lb. double crown may be used for a tympan. Four sheets of the same paper and a four-sheet cardboard may form the packing. Tympan sheets must be perfectly smooth and tight.
5. The forme should be carefully examined to see that it is in the right position and properly locked up.
6. The impression is regulated. If the fingers have a jerky motion, which tends to imperfect register, a piece of cardboard may be pasted on the tympan sheet directly under each finger, leaving the uppermost end of the card open, to allow of the sheets being passed under in the feeding.
7. A proof is pulled, and any low letters are packed from the back, or underlaid.
8. If a second working, the register is got from key forme.
9. The making ready is done on the platen.
10. The colour is carefully examined in regard to correctness and purity.
11. The proof is submitted to the overseer, and if everything is correct, and the register with the key forme is perfect, working off is proceeded with.

Order of Colours. Should the job in hand—say a demy 4to circular—be in two or three colours, the key forme may be printed first, if it does not overlap. But suppose the job contains a fancy border, one working of which is a pale blue tint, printing solid, overlapped by another working printed in carmine, the whole outlined by the key forme. In this case the key forme would be put on first, and the correct position obtained. Then five and twenty waste sheets would be pulled for use in registering the other colours, after which the blue would be worked off and allowed to dry. Then the carmine would be printed, and lastly the key forme—say in dark brown or black.

Clearness and sharpness in appearance are qualities to be aimed at in all colour work. However good the type may be, bad rollers or imperfect rolling will spoil its appearance. The ink must always be an important factor in any class of work. If too stiff, or of a putty-like nature, it will not work freely, and must be reduced until it distributes properly. A little thin or middle varnish will usually answer the purpose. There are, however, special preparations offered by the ink makers which some pressmen may prefer. Care must be taken not to overcharge the ink with any of these reducing mediums, or the colour will suffer.

Uniformity of Colour. Having started the job, watch the colour very carefully. Nothing detracts so much from the appearance of a job as a frequent variation of colour—now considerably in excess and then running down until there is little visible. This is quite as requisite as good making ready or good rollers. The man who cannot or will not keep his work at a medium colour is simply advertising his own carelessness or incapacity. Uniformity of colour is a matter in which a good workman will always take great pride. His eye should be so trained that he can at once detect the proper shade, and see just the quantity of ink required in order to produce the most satisfactory result.

Rollers for Colour Work. One of the essentials requisite for the production of good colour work is good rollers. Fresh or green rollers are not suitable. For varnish tints comparatively new rollers may be used; but for ordinary coloured inks of full body the rollers should be well matured.

For red inks, as a rule, fresh rollers are unsuitable, and only cause a waste of time.

Of course, in this matter, each one must be left to use his own judgment. There are various kinds of composition in use, all more or less affected by the atmosphere. A roller unfit for use to-day may answer the purpose better than any other to-morrow. If a roller be too fresh, there will be a difficulty in distributing the ink, or, if the ink is distributed, the forme may be "wiped" in the rolling. The roller may be too green, or damp, or tacky. Sometimes, if in such a condition, it will lay the ink on in rolling the forme one way, and wipe it off in rolling it another way. New or damp rollers may sometimes be made to work by washing them in turpentine and exposing them to a current of air.

When printing very small type, or fine engravings, a roller two or three weeks old is usually in about the right condition. If too fresh, the solid parts of the engraving will print grey. A roller in first-rate working order should distribute full-bodied colour, provided, of course, it is a fairly-good working ink—one which distributes easily and freely, and which lays the ink evenly upon the forme. A new roller, too fresh, often picks up only the varnish, and leaves the colour behind. Some colours require rollers which would be wholly unsuitable for others. Most of the browns may be worked with rollers comparatively fresh, as also may Chinese blue, and some of the greens. Vermilion must be worked with very dry rollers.

In offices where it is not possible to obtain rollers to suit the ink, the ink has to be made to suit the rollers. On a frosty morning when the rollers are hard, a little strong varnish mixed with the ink is often efficacious. When the rollers are fresh and damp, a little thin varnish may often be added to the ink with advantage.

It will sometimes happen that heavy bodied colours, such as vermilion or orange, will cake on the forme and rollers, because, in all probability the varnish in the ink is not strong enough to hold the colouring matter. This difficulty may often be overcome by adding a little strong or medium varnish to the ink.

Coloured inks are made in so many shades and qualities that it is possible to purchase, ready for use, almost any

shade that may be required. But it is sure to happen in offices where only a small stock of ink is kept, that a little of some particular shade is wanted in a hurry. With some experience and a stock of black, blue, red, yellow, and white inks, many other colours may be produced; in fact, almost anything likely to be required.

No less care should be taken when printing from type than is required in block work. Especially does a good job of typesetting rely for its beauty or effect upon the skill and care with which it is printed. Careful machine work may, to a certain extent, redeem faulty composition, but the best efforts of the compositor, even with new type and materials, will not save a job if the presswork is slovenly. So that if a job is to be a credit, good workmanship in the press room is absolutely essential.

CHAPTER XXIII.

PRINTING BLOCKS IN COLOURS.

THE following directions for the working of blocks in colour—the most advanced branch of colour printing—are by Mr. J. H. Harwood.

Proving the Key Block. The outline or key block should be locked up in a chase and securely fastened all around. It is not sufficient to lock it up on one side—it must be fastened beyond any possibility of shifting. Of course, when pulling “sets” or impressions for the purpose of registering the various colours into the key block no making ready is necessary, beyond merely levelling the impression by underlaying. The key block should be pulled in black or dark brown, and the colour used for the other blocks should be in strong contrast to that used for the key.

Making Ready. The colour printer should be familiar with the machine to be used, and should also understand the proper method of underlaying, the various ways of bringing up, and the arrangement of overlays. These are necessary in order that he may give the fullest effect to the work of the artist and the engraver.

In the first place, the block should be levelled, and care should be taken to see that it is type high. In doing this, there are two objects in view—the levelling of the impression and the effective rolling of the forme.

An engraving, when properly made ready, ought to show little or no impression. The light parts should be softened off, and the solids made quite firm. Each part of the engraving should print at its exact strength. The light parts must not be made to look rotten, neither should the impression be left so hard that some parts print thicker than is intended in the block itself.

In block work where several colours are required, there will be more or less white space in the blocks. Unless care

be exercised with both overlays and impression and also in using the right kind of packing for the tympan, the paper sometimes dips into these whites, spoiling the appearance of the job and endangering the register.

Each forme should be made ready with as light an impression as practicable. The tympan should consist of about six sheets of 36-lb. double crown, or its equivalent, a three-sheet board, and two top sheets, which should be drawn quite flat, and firmly secured beneath the clips.

Overlays. No hard and fast rule need be laid down with regard to overlays, for while it is undoubtedly true that there is a right and wrong way of cutting them, as of doing most things, yet the intelligent workman will always be able to vary his methods in order to get the best results possible from the job in hand.

Before commencing with the overlays, the machine minder should endeavour, by a careful study of the proof of the subject before him, to understand the idea and intention of the artist, so that his own part in bringing the job to a successful issue may be duly carried out.

In preparing overlays it is necessary first of all to decide upon the thickness of the paper to be used. Hence the nature of the block must be taken into consideration. When overlays are badly cut, or when the paper used is too heavy, the effect produced is anything but satisfactory.

Many blocks have parts which are intended to be quite solid, parts which are almost solid, and parts to be more or less dark or light. In such a case the deep or solid parts should be overlaid first. Sometimes these solid parts will require two or three thicknesses of paper, the parts next in depth probably one, and the lighter parts must be kept quite firm. It is absolutely necessary in the making ready of blocks to be careful to avoid all harshness in the impression.

Each part of the subject should be made to blend with the others. This can be effected only by careful making ready in conjunction with a correct choice of colours.

Succession of Colours. When printing a block in one colour only, the printer has the whole subject in view, and he can at once see the effect of an overlay. He has the result of his efforts before him. In a job consisting of several

colours, however, the general effect depends upon the careful and correct treatment of each forme. Hence the working in hand must be judged, not only by its present appearance, but by taking into consideration the alterations which will be brought about when other workings are added.

Let us now suppose that we have to print a job in four colours. We will take, for example, the Garden Scene shown as a coloured supplement in this Volume. The four colours used are yellow, red, blue, and black, the latter softened down almost to a grey. These colours are worked independently, and when they are overlapped they form other colours. The yellow mingling with the blue forms the green in the picture—the grass and the foliage of the trees. Here and there a slightly warmer shade of yellow is produced by the overlapping of the red. The mingling of the red and blue gives the violet seen in the flowers, while the blue printing over the yellow and red tends to produce a rich brown. The whole is outlined and deepened by the key block, which is printed in black considerably reduced with varnish.

In considering the question which is the proper colour to print first, the matter of correct register is not the only one to be discussed. This might lead to thoughtlessly putting on the block which gives the clearest outline of the job. The usual plan is to put on the key block, and register the others to it. Having done this, the blue may appear to show the design more fully than the yellow. The question may arise whether in this case blue should be the first working.

If the blue forme were worked first, the yellow would have to overlap it in order to produce the green, and the red to overlap it in order to produce the neutral brown. If this order of working were followed, the green would probably be too yellow in character, while the neutral brown would be too red. Accordingly, in printing the blue first there is a risk of the yellow and red elements unduly predominating, and in all probability the result would be most unsatisfactory.

Neither is it advisable to print the black first, as that is intended to give the finishing touch to the entire picture; the red is meant to print upon the yellow, in parts, producing a slightly deeper tone.

The yellow, consequently, is made the first printing. When the yellow forme has once been fitted into the key, it should not be unlocked, if this can be avoided. Everything must be perfectly clean. The proper shade of yellow would be lemon chrome, or one of the yellows specially prepared for this class of work by most printing ink manufacturers. This colour must be kept full strength, and worked off in daylight, as it is risky to work yellow in gaslight.

It is always advisable in doing colour work to have a sheet close at hand—which may be called a test sheet—printed with the requisite amount of colour, so that the colour of the sheets may be compared with this from time to time. Otherwise, even the most experienced is liable to go astray.

The red used should be either a scarlet madder lake, or one of the normal reds now so largely used for chromo work. Care should be taken to see that the ink is sufficiently deep in tone to produce the requisite shade of colour with the minimum quantity of ink.

This working is very important, and it is necessary to see that the impression is quite firm, otherwise the flesh tints so largely affected by this colour will appear broken, or rotten—a defect that it will be found impossible to remedy when printing the remaining colours.

The next working—blue—is not less important than the red. It falls over the yellow and produces the green of the foliage and grass; by printing over the yellow and red, it gives the brown shade on the woman's hair, and on the branches and trunks of the trees; it also forms the sky of the picture. The exact strength of the blue must be determined by the way in which it produces the green and brown tones it is desired to create. If too deep it will impart a general coldness to the whole. The sky will be dark and lowering, the green will be too deep, and the brown will lack richness; if, on the other hand, the blue is too pale, the sky will be weak and the green too yellow. It is very important, therefore, that the exact strength of the colour should be correctly obtained.

The last working is black, which may be softened down, or reduced, with thin or medium varnish almost to a deep grey. This colour is intended to fill in the detail, and to give a general look of completeness to the subject. It must not

be printed too strong, otherwise the picture will appear heavy, and lack sharpness and clearness, at the same time every detail must be brought up firmly and distinctly, and perfectly accurate register must be obtained.

When printing a subject in three colours only, similar methods are employed. It is not necessary or wise to depart from the ordinary chromotype colours, yellow, red, and blue, except of course to vary the strength or quantity, according to the nature or requirements of the work in hand. In this case the blue block may be treated as the key. It usually has more detail than either the yellow or the red. Yellow should be the first working and blue the last.

In order to produce good work of the class already described, a rigid impression and plenty of rolling are absolutely essential.

CHAPTER XXIV.

GROUND TINTS.

WITH the view of giving greater effect to some kinds of printing—especially colour printing—backgrounds are often used, consisting of a somewhat light or pale shade of colour, printed upon the paper. These backgrounds are called ground tints.

Ground tints may be used for portions only of the composition, in the shape of panels; or they may be used for embellishing and emphasising separate lines. The subject divides itself into two parts—(1) The formation of the ground; (2) the colour for printing it.

Formation of the Ground. There are two kinds of tint grounds—flat tints, such as would be produced by printing from a plain unengraved plate of metal; and tints showing geometrical or natural forms, such as would be produced by printing from borders or from a piece of wood of coarse grain. The variety of materials which may be used for the purpose is very great, and it affords much scope for the display of taste and ingenuity on the part of the printer.

The following are some of the methods which have been practised:—

Ground tints may be made from *metal plates*, either cast plain, or with designs from bookbinders' cloth or embossed paper. The ordinary stereo box may be used. They should be trimmed after casting to the exact size with the aid of a mallet and a sharp chisel, and afterwards fixed on a mount in the usual way.

To prepare these, a pull should be taken of the key forme, well inked; this should be laid on the plate—which is placed on a stereo mount—face downwards, and well pulled in the press, thus transferring the design to the metal plate. It is now ready for cutting.

As there may be some difficulty in transferring the design

to the metal for the purpose of cutting the latter to fit, recourse may be had to this plan. Pull a proof of the key forme, and cut away from it with a sharp knife such portions as require tinting. Place the paper face downwards on the plate and mark all round the edges where the ground is required with a pen and ink. Then cut the ground with mallet and chisel.

Borders. A great number of designs can be made from these if they are of a geometric character. They are composed and stereotyped in the usual way.

Lead etched with acids or acted on with sand.

Chemicals. Take a strong solution of Epsom salts and with it cover the face of a piece of plate glass. Let the salts evaporate very slowly. When dry the glass will be covered with a foliated network of crystals, somewhat like window glass on a frosty day, except that when properly done the crystals will be separate, and not connected at the edges. A mould can be taken, by pressure, on wax, from which the salts can be washed out by water, and an electrotpe taken from this.

Oxalic acid similarly treated gives a beautiful crystal, but the depth of the plate must be increased chemically or used only on fine paper with superior ink.

Wood. A block of knotty, irregular grained wood may be planed across in the direction in which the grain is most distorted. Then soak it in sulphuric acid, and the softer parts of the wood will be burnt away faster than the harder parts, so that the grain will appear in ridges and hollows. It may then be electrotyped.

Upon a strip of engraver's wood may be laid a piece of emery or sandpaper, with several pieces of cardboard on the top. If a heavy impression is taken in a press the result will be a well granulated surface, quite deep enough to print from.

Cardboard. To make use of this handy method, the lines of the design are obtained by making an impression of the inked forme on the tympan sheet, and while the ink on the latter is still wet, without moving the forme, pull on a thick, smooth-faced card. Repeat this until sufficient cards are obtained for the different colours desired—two or three cards for each colour. Also pull a sheet of paper for each colour in

a similar manner. Cut the design out of two or three cards—according to the thickness of the plate required—with sharp scissors, always working from the back or set-off side of the card. Coat the surface of an ordinary stereo block with thin glue, and stick the sheet of paper on it, face downwards. The object of gluing the block instead of the paper is to avert the possibility of the paper expanding or contracting. By this means a true outline of the forme is secured. Proceed to glue the cards—two or three according to the thickness required—on to the block, using, of course, a different block for each colour. Then place the block under a weight or in a press for a few minutes. When sufficiently fast paint the surface evenly with thin glue, and cover the whole over with thin tissue paper, taking care to rub all around the edges with the thumb and forefinger. Put in the press again for a few minutes. When sufficiently dry, paint the surface again with a solution of glue and water, and allow it to dry, when the block will be ready for use. When required for long runs an additional coat of oak varnish, thinned with turpentine, should be applied; in fact, if time permits, this is always preferable. Care must be taken that the plates are perfectly dry before working.

Another way. If desirable, the cards—two or three in thickness—can be stuck on the block and the outline drawn. Or, the outline can be obtained by pulling a proof of the forme, well inked, and placing it face downwards on the tint block, and pulling. The set-off will give the outline. The design can be cut out with a sharp-pointed knife. The face of the block may then be prepared as before mentioned. For a diagonal tint a repp paper should be used, instead of the tissue, using stiffer gum. A mottled surface can be obtained by using antique hand-made or similar paper. By this process of preparing plates trimming is rarely necessary, and chipping entirely obviated. The plates, however, cannot always be relied upon if stiff ink is used. In making ready on either machine or press, a heavy impression will assist in levelling the blocks. Clean with a soft rag or sponge, and a little turpentine or paraffin.

Bookbinders' Cloth. Make a stereotype cast directly upon the cloth in an ordinary stereo casting box. If the latter

is not available, any type-high frame, say of pica brass rule, locked up in a chase and placed on an iron imposing surface, will answer equally well, a big iron spoon held over a gas jet serving the double purpose of melting pot and ladle. Before making the cast, take a piece of Bristol board and lay it on the bottom of the box while in a horizontal position. Then lay on the top of it the piece of book-cover cloth, face up, adjust the type-high bars to the size desired, and close the box. Have the metal about the same temperature as in ordinary stereotyping, then pour in quickly, and the plate is made. Some book cloths will give a different pattern from either side, if those with a well defined grain or design are chosen.

2. *Colours for Ground Tints.* Tints for printing purposes are made in two ways: (1) By adding a small quantity of colour to a greater quantity of white ink; (2) by adding the colour to varnish. When it is possible to use tints made with varnish alone, they are preferable to those made with white.

The main points to be noted in printing tints are that they should be pure and bright in colour. This result can only be obtained by observing the greatest cleanliness in the preparation of the ink. Beyond this the tints produced should be perfectly flat and even all over. This is secured by having both ink and rollers in a satisfactory condition.

White and Varnish Tints. The question may arise where and under what circumstances is it right to use tints prepared in one or other of these ways. One strong objection to the use of white is that it has a tendency to clog, and not work freely. There is also the liability of its changing colour, thus impairing the purity of tints made with it, when exposed to light and air. The advantages possessed by tints made from white are that they afford the best means of obtaining greater fulness and richness—especially with some colours—than would be possible with the purely varnish tints.

For solid tints where it is desirable that the ground should as far as possible be blotted out, the opaque colour is preferable.

Where gold is a last working, any light tones forming the previous workings are better made with white, because they dry harder than if they were made with varnish, and there is less danger of the gold adhering to them.

It should always be borne in mind that pale tints made

with white, especially blue or pink, become paler as they dry. Allowance should be made for this.

Varnish tints are more suitable where a great body of ink is not required.

Again, where pale tones are intended to print over and modify each other, they should be mixed with varnish, because the effects designed to be produced by one colour printing on another are only realised when the inks are transparent.

The Graduated or Vanishing Tint. This is a tint which is of full strength at the top of the page, and gradually grows paler, even to vanishing point at the foot of the design. Mr. Robert Grayson gives the following account of the method, as utilised in *The British Printer*. He uses for this class of work a platen machine with a disc ink distributor above the forme, and a duplex distributor below. It is by the aid of the latter arrangement that the graduated effect is obtained. The disc is made to revolve for the purpose of providing a more perfect distribution of ink. To stop the disc is to allow the ink to accumulate on certain parts of its surface, and as this becomes transferred from the disc to the rollers, and from the rollers to the forme, the latter yields an impression which has the appearance of being imperfectly rolled. This can, however, be obviated if there are any other aids to distribution attached to the machine. In the Golding Jobber the duplex distributor consists of an iron slab fixed below the forme, and over which the inkers pass and re-pass every time an impression is taken. This slab has a lateral motion of about half an inch, causing the rollers to ascend in a slightly altered position from that they were in when descending. The movement ensures better inking of the forme, but in this particular instance it does more, it imparts just sufficient vibration to the rollers to blend, or partially distribute, the ink that is found in streaks upon the stationary disc.

The ink duct is fixed immediately above the disc on the right-hand side of the machine and extends barely half-way across it. To obtain a graduated tint the forme must be placed in chase so that the part requiring full strength of colour falls below the ink cylinder, and that portion requiring

little or no colour should be on the left-hand side of the machine—the side furthest away from the ink duct.

Arrange the ink in the duct so that the flow falls exactly opposite the part of the forme requiring full colour, and let this be the only source of supply. To do this properly it is necessary to have pieces of metal the correct shape of the ink trough, and the ink should be walled in between two of these. Having secured the disc so as to prevent its rotation, the supply of ink will be delivered in one narrow strip down its surface. The action of the duplex distributor, however, causes the rollers to spread the ink, in a gradually diminishing quantity, across the disc from right to left, though, of course, the colour will always be the strongest on the right side, immediately under the source of supply.

On a cylinder machine the placing of the forme and the arranging of the ink trough would be similar to that already described, but the wavers of the distributors would require to be put almost straight—a very slight lateral motion sufficing to produce the desired effect.

A chromatic arrangement is available for platen machines, consisting of an ink cylinder the full width of the disc, furnished with the necessary fittings for dividing the ink trough into several compartments. The tints are arranged in the order desired, and are delivered by the duct roller on to the stationary disc in a series of streaks. The duplex distributor previously mentioned again does duty and blends the various tints. If the colours are wanted to run diagonally across the printed page, the forme must be placed diagonally in the machine chase, and the sheets fed slantwise on the tympan.

Mr. J. F. Earhart, the late American colour printer, considered that for colour or tint blocks boxwood is preferable to anything else. For labels, showcards, etc., stereotype metal answers the purpose just as well; but for fine work in which delicate tints are used, boxwood is certainly the best. The stereotype metal is sure to have a bad effect on some tints, making them duller than when printed from boxwood. It is necessary to be more careful with the wood than the metal, to prevent it from shrinking, warping or swelling, which would cause the block to be out of register.

To make transfers for a job in several colours, first put a very thin coat of Chinese or flake white on the surface of the blocks, then take the number of impressions desired upon pieces of smooth thin Bristol board, using a good black ink. Before printing the transfer cards, an impression must be taken on the tympan, so that the cards will set off on the back when being printed. Then take the block for the first colour, and fasten one of the cards upon it face down, with small drawing tacks. Be sure to stick the tacks in those parts of the wood which will be cut away. Then take a bone paper knife or folder, or the handle of a tooth brush, and rub hard upon those parts of the job which are intended for that particular colour. With care the transfer will be almost as sharp as the original print, and it will, besides, be absolutely accurate. After the blocks are engraved, rub their face thoroughly with a soft cloth, saturated with boiled linseed oil, then wipe them dry, and they are ready for use. After the printing is done, the blocks ought to be wrapped in dry paper and placed on edge upon a shelf in a dry place.

The simplest method of obtaining perfect register in a job in colours is as follows. Make the forme ready, and set the guides very carefully. Then print forty or fifty register sheets or cards, and be sure that every one is down to the guides before printing. It is best to print the cards or sheets with a grey ink. It is of the utmost importance that they should be fed to the guides with absolute accuracy. Each colour can then be registered in its proper place with a certainty of getting a perfectly registered job.

In the method above described special colour blocks have to be provided for each job, and these are generally useless for any other purpose. Besides this it is considered necessary to work the tints before the black, and this involves much preliminary work, as the black and colour formes must be made to register exactly before the machine can be started on the first colour forme. Ornamental material for tint grounds is, however, available from every typefounder, and by utilizing these expense is greatly reduced, as the same pieces can be used over and over again for different jobs, and, if ordinary care be exercised, the black forme can be

worked off at once, and the trouble of obtaining exact register is reduced to a minimum.

In displaying a job to be worked in colours in this manner, the prominent lines are put in panels of brass rule or border, taking care to have the enclosing rules an even number of points apart. The job is then put on the machine and run off, feeding the sheets squarely up to the gauges.

The black, or key forme having been printed, the next operation is to arrange pieces of the tint material to fit the panels, and to justify them so that they will fall into their proper places.

When the ink from the first forme is dry, the tints selected can be worked over the black, or whatever colour may have been used. To get good results it is necessary to use a transparent white ink which will not dim the lustre of the colours over which it is worked. The ink disc and rollers of the machine must be perfectly clean.

Baker's Stencil Tinting Process (invented by Mr. John Baker, Birmingham) is a simple method of tinting small job work upon the platen machine, and of dispensing with the necessity of having a block cut or the use of one of the expedients already described. The process consists in placing a type-high block in a chase in the bed of the machine, and attaching to the platen a hinged frame, covered by a sheet of thin fibrous substance. Out of the latter is cut the shape of the required tint. The frame is hinged at the bottom, one part of the joint being held fast by the lower tympan clip; the upper part of the frame being loosely secured to the gripper fingers. The frame is therefore actuated by them as they rise and fall with the motion of the machine.

The cut-out space in the jointed frisket determines the shape of the tint, acting as a stencil, in coming between the blank sheet of paper laid on the platen and the inked surface on the type bed.

The time required for preparing the plate and producing a clean bright tint is a mere fraction of what is needed under some methods. An extra distribution of ink is possible, without double rolling, and solid tints are printed with less than half the usual impression.

Kampe's Tint Block Process consists mainly in the use of a

specially prepared cardboard, composed of sundry layers of paper. The surface of this board is covered with a special kind of enamel, which can be easily manipulated, and a special solution serves to harden the surface before printing from it.

The board covered with this solution forms an exceedingly hard surface, proof against the pressure of the printing machine, and also against the effects of the chemicals mixed with the printing ink. The longer used the harder becomes the surface.

When requiring the plates for use a piece, according to the size of the design to be produced, is cut from the plate. This piece is glued on a wood block, as used for electros and stereos, made of the proper thickness to correspond with the height of the type. After gluing the board on to the block the surface is covered with a sheet of paper and then subjected to gentle pressure in a press until quite dry.

In order to transfer the design to the tint plate, the key block, consisting either of brass rules or complete ornaments into which the tints are to fit, is inked with printing ink. An impression on good paper of medium thickness is then taken and placed face downwards on the tint plate. By means of a hand press, litho press, or even on small jobs by rubbing the back with a paper knife, the impression is transferred to the tint plate, which will show the design in clear outlines.

After completing the transfer and mounting the plate on a wood block the design is cut out. First the outlines of the design are engraved into the surface by means of an engraving needle, utilising an ordinary ruler for straight lines and a compass for circles. After having thus marked the outlines the chisel and scraper come into use. The chisel with its straight edge against that part of the design which is to remain, is pressed downwards, thus separating entirely the design from all the superfluous parts. The latter are removed from underneath with the chisel. In order to clear away any raggedness of the outlines, they can be smoothed by drawing the flat surface of the chisel alongside the edge. The outlines of complicated designs require the use of a scraping tool, like an ink-erasing knife.

As the surface of the plate in its original state is quite soft,

it will allow of designs being worked either by engraving or by pressing them in from existing ornaments of type metal.

Special wood letters for posters, initials, etc., may thus be produced. If no design exists it may be drawn on the plate ; if a design exists a tracing may be taken of it with pencil and laid face downwards on the tint plate, and the lines drawn over a second time. Illustrations in white with black or coloured grounds may be produced. Besides the plain surfaced plates, lined, stippled, and marbled ones may be used.

The plates are cleaned by means of a piece of flannel saturated with paraffin or turpentine.

Baker's White Letter Etching Process. This is an ingenious method of producing plates for printing in white letters (if the paper is white, or in any other ground colour), patented by Mr. John Baker, of Birmingham. The general principle is that of pulling impressions of type formes upon and into a composition spread upon paper ; of afterwards transferring this type impressed composition to a zinc surface, and pouring over it an etching solution, which eats away the metal at all parts that have been removed from the composition by the impression of the type. The composition is a waterproof substance and is transferred from the paper to the zinc by moistening the back and pressing in a hand press or copying press. The composition protects the metal at all parts not picked up by the surface of the type previous to transferring. The etching solution eats away the zinc very quickly, and a good plate can be produced in half an hour. The composition can also be removed by a pen, pencil, or needle point, the slightest mark in the composition producing depressions in the plate. The writing or drawing is, of course, right handed, and shows on the ground exactly as it will appear when the plate is printed from.

The transferring of the ground is done in the following manner :—The ground is placed face downwards upon the metal surface which is to be etched. Three or four sheets of blotting paper, well soaked with water, are laid on the back and the whole is then pressed. When taken out of the press the moisture from the wetted blotting paper will be found to have permeated the basis, dissolving the ground. The basis can then be readily removed, leaving the ground adhering by

its face to the surface of the metal, which remains bare and exposed wherever the ground has been removed.

The metal plate having the ground adhering to its surface, is placed in an acid bath or a tray containing a solution of a metallic salt, such as perchloride of iron for a copper or brass plate, or sulphate or chloride of copper for a steel or zinc plate. In a few minutes the plate will be found to be etched to a depth corresponding to the strength of the etching composition, and deep enough to be printed from.

A plate designed and etched in this way can be printed from in an ordinary press, showing white lines on a dark ground, or the plate may be printed from by the copper or steel plate method, producing ordinary black lines on white paper. By etching the plate considerably deeper, embossing dies are formed, as explained in chapter xxvii. on embossing.

CHAPTER XXV.

THREE-COLOUR PRINTING.

THIS is a process—variously named photo-trichromatic printing, chromotypy, heliotypy, and photo-chromotypy—whereby all the colours found in an oil painting, all the colours of nature, are produced by three printings of three blocks. It thus differs from ordinary colour printing in which as many blocks and workings are required as there are tints and colours, unless some of them can be varied by superposition in printing.

The advantages of the process are that (1) only three blocks are, as just mentioned, required for any number of colours; (2) the blocks are more cheaply produced than if the tints were laid down upon the lithographic stone; (3) the printings are more expeditious, being done on letterpress machines, besides being only three in number; (4) throughout the whole operation less skilled labour is required than in lithography, thus reducing the cost of production.

Three-colour printing is a combination and a utilisation of several processes, such as photography, line and half-tone negative making, etching of plates of metal, and letterpress printing. These produce a set of blocks, each containing a reversed image in relief and representing its own primary colour, so that when the three prints are superimposed the result will be a more or less perfect reproduction of objects in the colours of nature.

Rationale of the Process. An ordinary photographic negative represents the light and shade of an object, but reversed as to its natural appearance; the sky appearing black and the shadows white, and the half-tones in proportion.

Bichromated gelatine, or fish glue, has the property of becoming insoluble on exposure to light; thus a reversed negative of a B printed in black ink on white paper would show the B as transparent on a black ground. If this negative

be placed on a zinc plate coated with bichromated glue, the light acting through the transparent B would render that glue insoluble in water; but the black part of the negative having kept the light away from the sensitive glue, this would wash away. The B would therefore be in relief, and if sufficiently high and hard, would print like an ordinary engraving. This, however, would not serve the purpose, so the B is heated to an enamel which resists the acid into which the plate is put, and the acid eats away the plain zinc, thus leaving the B in distinct relief, as if it were a letterpress block. If, however, an ordinary portrait or landscape negative be so treated, the letterpress relief is not obtained—a special negative is required, called a half-tone negative, which must, of course, be reversed to produce the reversed image required.

The half-tone negative is made by placing in front of the sensitised plate a screen, ruled crosswise with a diamond, and having from 70 to 150 or more lines to the inch. This breaks up the image into a series of very fine dots—or lines in the case of a single-line screen—the dark lines producing transparent lines on the negative, which again allow the light to pass on to the bichromatised glue, and so make it insoluble. The other parts into which the picture is broken are dissolved on washing and present clear zinc (or copper) for the etching mixture to dissolve away. This gives the relief required. The light spreads in proportion to its intensity, and so produces a negative having black dots in the shadows, white dots in the high lights, with a chess-board effect of square dots in the half-tones. From this the ordinary half-tone block is produced.

Three-colour blocks are produced by the use, in the camera, of colour screens, violet-blue, green, and red. When one of the colour screens is placed in the rays of the spectrum, it absorbs all other rays but its own. Thus, if a coloured picture or view from nature be taken with a violet-blue screen interposed, only those rays will pass on to the sensitive plate. So also the red will allow all red rays to pass, whether they be pure red, or seen in the object in orange, purple, or other combination. Thus by using the three screens, three negatives can be obtained which represent these three colours, no matter in what combination they may be found.

From these three negatives positives (or transparencies) are prepared, and from the latter three blocks are made, which, when printed in the *complementary* colours of the negatives, i.e., yellow, red, and blue, exactly reproduce on paper the varied hues of the original object. The lines on the three blocks being some 133 to the inch, the eye barely detects the composition, though under a powerful magnifying glass the lines and dots are plainly distinguishable.

Instead of screens, glass troughs are sometimes used, constructed of two parallel sheets of glass, sealed all around, and holding in the intermediate space a coloured liquid. This liquid generally is a solution of aniline dye of the requisite shade.

Working from the blocks. Hard packing is necessary for this kind of printing. Perhaps the best tympan consists of eight or ten sheets of cream wove paper. Great care is required to arrange an equal distribution of the inks throughout the runs and to ensure perfect register. No pains should be spared, too, in the making ready of the blocks.

It is most important that each colour be dry before the next is printed.

The printing inks should be used in the same condition as that in which they come from the makers. They usually work very stiff, and large blocks check the speed of the machine. If it is absolutely necessary to thin the ink a little, a small quantity of thin varnish may be used.

In his admirable work on "Photo Trichromatic Printing" Mr. C. G. Zander points out that the success of photochromatic work depends on the blocks, on the inks, on the printer, and in a certain degree also on the paper. The blocks must be produced by colour filters constructed on scientific principles. The printer must do his part not in a purely mechanical style, but should have at least some knowledge of the rationale of the method—the lack of which is, at present, a serious stumbling block in the way of the progress of photochromic printing.

One of the crucial tests of good photochromic work is the production not only of a correct rendering of the colouring of the original, but the production of neutral blacks and greys wherever they appear in the original. The carelessness

of many ink makers has caused much mischief in bringing into disrepute one of the most interesting achievements of modern science. Many inks vary, not only in the shades but in the strength of the pigments used in their manufacture. For instance, fugitive lakes have been used for the red, which after a few days' exposure to the light fade, and render the colouring of the whole picture incorrect. The three pigments which alone produce a correct colouring are :—

1. A pure red pigment, one that is neither a purple nor an orange, but is the primary red of the artist ;

2. A yellow which is a pure yellow, not inclined either to orange or green, i.e., about the shade of sulphur, or what artists' colourmen call "lemon yellow" ;

3. A blue, or cyan blue, somewhat similar to a greenish cobalt blue. Neither the violet nor the green should, however, preponderate in the blue.

If these three inks are correctly made it will, by their mixture, be possible to produce every colour, including tints, saddened hues, and dense blacks.

The second essential quality of the inks is transparency. Unless the pigments are transparent, the peculiar effect of the superposition cannot take place. Wherever, for instance, an opaque red dot should cover a yellow one, instead of producing an orange or scarlet, it would only show the colour last printed. But if the red is transparent it will combine with the yellow to form orange. Again the colours must be permanent.

In printing, the usual order is yellow, red, blue.

The best paper is a coated art paper, without any grain. For common jobs a super calendered paper will suffice. Mr. Zander gives the following suggestions. He points out that if a pigment, such as madder lake, is rubbed up either in plain water or gum water, and painted on a sheet of hard, well sized and glazed paper, a bright red will be obtained, owing to the smooth surface of the paper reflecting some white light with the pigment, making the latter appear bright. If a sheet of white blotting paper be taken, and painted with the same colour, the result will be a kind of dirty maroon, or claret colour. The blotting paper absorbs some of the light which the glazed paper reflects. The lesson is obvious, that

there should be used only good paper, hard, well sized, and glazed.

Three-colour blocks are produced in the form of originals, etched on copper or zinc. The copper "blocks" are preferable. The reason is that zinc is a metal which readily absorbs moisture, whereby oxidation is set up, the effect being to render the plate brittle and spongy. This can be minimised, however, by careful drying after washing and the application of a coating of "D.M.V." to the surface. Copper is not so liable to injury through moisture.

In preparing these plates for the machine it is necessary at the outset to see that they are mounted on perfectly level blocks of hard wood, securely fastened, squared, and of proper height, so as to secure perfect inking, with a solid and even impression. The blocks must be perfectly clean.

It may be here mentioned that the Mole Patent Mechanical Underlay, for bringing blocks to type height, and the Mole "Perfect Register" Quoins have done much to facilitate working conditions in three-colour printing.

As to the class of machine most suitable for working these blocks some discretion will be necessary. For a large block a machine should be chosen which permits of great accuracy of register and strength of impression.

When electros of these blocks have to be used they may be nickel-faced in order that the copper may not interfere with inks which are susceptible to change when in contact with it. Or the blocks may be treated with the following solution, applied by a soft camel-hair brush, which gives them a facing of silver:—Nitrate of silver, $\frac{1}{4}$ -oz. ; chloride of ammonia, 2 drams ; hypo-soda, $\frac{1}{2}$ -oz. ; precipitated chalk, $\frac{1}{2}$ -oz. ; water, 4-oz. The blocks should be mounted on hard wood, like the originals.

CHAPTER XXVI.

BRONZING MACHINES.

INSTRUCTIONS for bronzing by hand will be found in another chapter. When quantities of work are to be bronzed within a limited time, machines specially devised for the purpose are utilized. Furthermore, hand bronzing is discouraged by the authorities as prejudicial to health.

Machines of this class automatically lay on the bronze powder, dust off all that is superfluous, and burnish the work. The usual type of bronzer is fed similarly to a cylinder printing machine, whilst a metal cylinder and a number of rollers revolving in a trough of bronze are supplemented by other rollers which wipe off the surplus bronze, a rubbing-in pad, and a polishing roller completing the equipment. There is automatic regulation of the bronze powder for light or for heavy work, with a device for diverting any surplus bronze into the bronze trough and so minimizing waste.

A description may be given of a Standard Bronzing Machine widely in use.

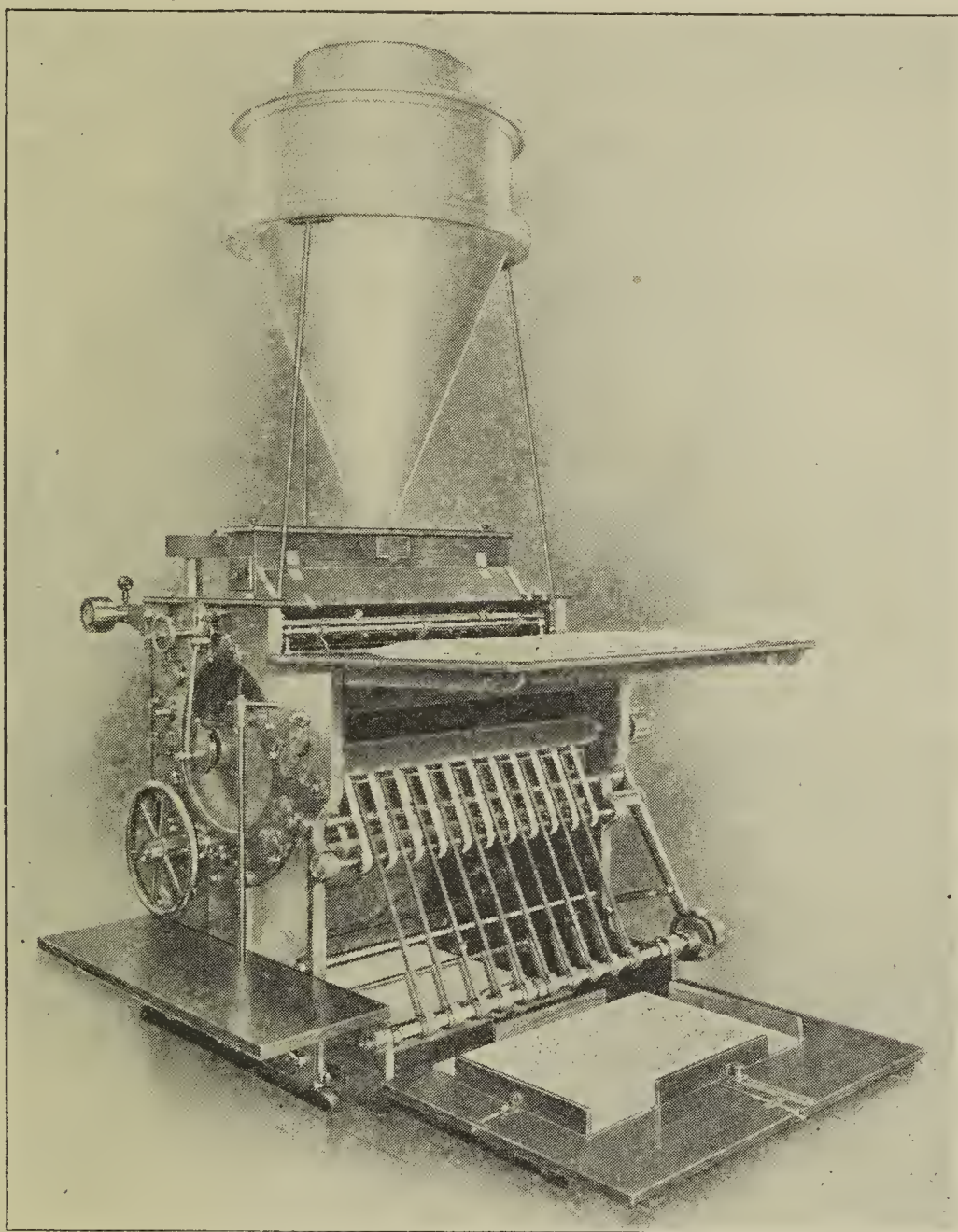
THE SAFETY VACUUM BRONZER.

The Safety Vacuum Bronzing Machine (Mark Smith's Patent), Taylor, Garnett, Evans & Co., Ltd., South Reddish, was the result of careful experiment to overcome the well-known objections to old-time methods of applying bronze powder to paper.

It is made in six sizes. The dimensions of a $35 \times 22\frac{1}{2}$ in. machine are : height over all, 8 ft. $9\frac{7}{8}$ in. ; height of body, 3 ft. $7\frac{1}{2}$ in. ; depth over all, 6 ft. $11\frac{5}{8}$ in. ; width over all, 5 ft. $7\frac{7}{16}$ in.

A glance at the illustration shows that the arrangement of feedboard resembles the usual cylinder printing machine ; indeed, the sheet is fed from the board and gripped "Miehle" style, the speed being about the same. The sheet enters

over a cylinder and under a duct holding the bronze supply. The powder is sprinkled in a fine spray from a plush-covered roller, effected by means of a knife adjusted hard-on to cause



Safety Vacuum Bronzing Machine (Mark Smith's Patent).

the plush bristles to spring and flip off the bronze like a vapour. Two more rollers continue the work of bronzing, and the cylinder further carries the sheet against two burnishing pads. The continued journey next brings the four cleaning rollers into play, and these do their work very thoroughly, cleaning the very coarsest cover papers, of

Whatman-like textures, as easily as enamelled surfaces. The sheet then reaches the taking-off cylinder, being dusted on the back by new rollers ; it then slips on to flyers and is delivered on the board to be kept straight by a jogger, automatically. Thus one girl can easily feed and keep the machine going. The vital principle of the machine is that by means of the fan at the base, the pipe at rear, and the large inverted cone above called the "cyclone," a partial vacuum is created *within the machine* and bronze is prevented from escaping into the room. The air and superfluous bronze pass through the "cyclone" and are separated, the bronze returning to the feedbox and the air escaping through a hood or pipe to the outside atmosphere, either through the roof or side wall or window.

The machine is very simple in action, is readily accessible in all parts, and quickly inspected and cleaned. No dust can escape. A sieve placed in front of the fan prevents any paper or rough material mixing with the bronze when circulating. The fan of the double demy machine can be operated by a $\frac{3}{4}$ h.p. motor, a 2 h.p. motor driving the machine itself independently. So long ago as 1896 the Factory Inspectors commented most favourably upon the humane qualities of this machine, and its additional labour and bronze-saving merits and speed render it a sound business investment. Perhaps the most striking testimony is the fact that eminent American and German printing houses are eagerly buying them—one foreign firm having fifteen in use ; equally keen are home printers—twenty-five being installed in one large house. Recent Home Office regulations for bronzing, to safeguard the health of workers, render such a machine a necessity.

SOME OTHER BRONZING MACHINES.

This is a small horizontal bronzing machine, 33 in. long by $13\frac{1}{2}$ in. high. It is devised for card bronzing and is widely in use for Christmas card work. It dusts both sides, delivers automatically, and rollers are self-cleaning and self-adjusting.

Messrs. A. Edler & Co. have placed the Kohlbach bronzing machine in a number of British offices. In this the ordinary

rotary brushes are displaced by patent wipers. The sheet is led in with feeding rollers, whilst the absence of cylinders and grippers obviates any tendency to stretch the paper, and a high speed results. Sheets are simultaneously bronzed and dusted, any bronze surplus is automatically gathered in a chamber for re-use, and the rollers are totally enclosed during operation.

The firm of Geo. Mann & Co., Ltd., handle a dust-proof machine in their Newsum pattern and the Schmiers machine. The latter is made in various styles and possesses an exhaust device designed to extract the loose bronze. The machine is complete with regard to bronzing, dusting and burnishing.

CONDITIONS GOVERNING BRONZE PRINTING.

Very stringent regulations have been made by the Home Office in respect to the conditions under which bronzing is carried out in factories or workshops. These include letter-press and lithographic printing, and the rules came into force June 1, 1911.

EXEMPTIONS.

Regulation 2 shall not apply to—

- (i) *Bronzing* by hand for the purpose of proof-pulling ;
- (ii) *Bronzing* by hand in a factory or workshop in which such work is not done on more than one day in any week or on more than six days in any twelve months ; provided that this exemption shall be subject to the following conditions :—
 - (a) Notice, in the prescribed form and with the prescribed particulars, shall be affixed in the factory or workshop not less than seven days before any use is made of the exemption, and shall be kept so affixed as long as the exemption is used ; and a copy of such notice shall at the same time be forwarded to the inspector for the district ; and
 - (b) The prescribed particulars shall be entered in the prescribed register before the commencement of the work on each day on which any use is made of the exemption ; and any day in respect of which such entry is made shall be counted as a day on which *bronzing* by hand has been done.

DEFINITION.

In these regulations—

Efficiency exhaust draught means localized ventilation effected by mechanical means for the removal of dust so as to prevent it as far as practicable from escaping into the air of any occupied room. No draught shall be deemed efficient which fails so to remove smoke generated at the point where such dust originates.

PART I.—DUTIES OF OCCUPIERS.

1. *Bronzing* by machine shall not be done except under such conditions as to prevent as far as practicable the escape of dust into the air of any occupied room.

2. Subject to the exemptions hereinbefore mentioned, *bronzing* by hand shall not be done except in connection with an *efficient exhaust draught*.

3. There shall be provided and maintained in a cleanly state and in good repair, for the use of all persons employed in *bronzing*, a lavatory, under cover, with a sufficient supply of clean towels, renewed daily, and of soap and nail brushes, and with either—

(a) A trough with a smooth impervious surface, fitted with a waste pipe without plug, and of such length as to allow at least two feet for every five such persons, and having a constant supply of warm water from taps or jets above the trough at intervals of not more than two feet ; or

(b) At least one lavatory basin for every five such persons, fitted with a waste pipe and plug or placed in a trough having a waste pipe, and having either a constant supply of hot and cold water or warm water laid on, or (if a constant supply of heated water be not reasonably practicable) a constant supply of cold water laid on and a supply of hot water always at hand when required for use by such persons.

4. There shall be provided—

(a) Suitable overalls for all persons employed in *bronzing*, and headcoverings for females employed in *bronzing*, which shall be collected at the end of every day's work, and be washed or renewed at least once every week ;

(b) For all persons employed in *bronzing*, a suitable place or places for clothing put off during working hours.

PART II.—DUTIES OF PERSONS EMPLOYED.

5. Every person employed in *bronzing* shall—

(a) Wash the face and hands before partaking of any food or leaving the premises ;

(b) Wear the overalls provided in pursuance of Regulation 4 (a) ;

(c) Deposit clothing put off during working hours in the place or places provided in pursuance of Regulation 4 (b) ;

and every female employed in *bronzing* shall wear the headcoverings provided in pursuance of Regulation 4 (a).

6. No person employed shall—

(a) Introduce, keep, prepare, or partake of any food or drink (other than milk or tea provided by the occupier) in any part of the factory or workshop in which *bronzing* is carried on ;

(b) Make use of tobacco in any part of the factory or workshop in which *bronzing* is being carried on ;

- (c) Interfere in any way without the concurrence of the occupier or manager with the means and appliances provided for the removal of dust, and for carrying out these regulations.

On certain points there appears to have been some misapprehension, which the following explanation may serve to remove :—

Reg. 1 does not require enclosure of bronzing machines in partitioned spaces if the conditions are such as to prevent the escape of dust into the room. For example, a modern machine, the working parts of which are so enclosed as to prevent the escape of dust, will conform to this requirement.

Reg. 2 requires an “efficient exhaust draught,” and this expression is defined in the earlier part of the regulations. The draught may be upward, downward or horizontal.

Reg. 3 requires a lavatory *under cover*. This does not of necessity imply that a separate room shall be provided for the purpose.

Reg. 6 (a). The prohibition of use for meals of that part of the factory or workshop where bronzing is carried on has already been in force for several years under the order of March 23, 1898 (made under s. 39, 1878, now s. 78 (4), 1901). The question has been raised whether in an exceptionally large room this regulation would prevent the use for meals of a part remote from any bronzing : the reply is in the negative. For other parts of the works the regulations do not prohibit the introduction of food, etc. ; and as regards the bronzing rooms Regulation 6 (a) expressly allows tea or milk to be provided by the occupier.

Reg. 6 (b), with regard to the use of tobacco, applies only to the bronzing room.

CHAPTER XXVII.

EMBOSSING BY LETTERPRESS PROCESSES.

THE effect of some kinds of ornamental printing is enhanced by embossing part of the surface of the paper. This part rises towards the reader. The design may consist of letters, or ornamental figures, or a combination of both. Obviously the impression must be made from the back, and with types or characters which are not reversed.

From time to time many excellent specimens of embossing have appeared in *The British Printer*, and Mr. Robert Grayson has given the following account of the method by which some of them were produced. Several were produced entirely from borders and brass rules, such materials being found in nearly every printing office. Old and discarded two-colour borders will be found of use for this work, and the silhouette borders, so much in vogue a few years ago, are available.

It is, of course, the cut out, or sunken, or intaglio portions of borders that give the desired effect in embossing. Having prepared the forme, attention must be given to preparing the platen machine for the actual embossing. Many methods present themselves for adoption. Supposing it is merely a band of ornament across the top and bottom of the page, or a panel only, that requires to be embossed, and the number of runs is not large. The forme is placed on the machine and made ready by underlaying any part that does not appear to be type-high, especially the brass rules. When the impression is even a pull is taken on the tympan sheet, there being about as much impression on the forme as if it were to be printed in ink. The tympan sheet should be of good strong paper, manilla being the best.

The rollers are now removed. The forme is cleaned with benzine, and brushed over slightly with oil. Out of a sheet of good blotting paper are cut two pieces larger than the part to be embossed. One of these is laid on a flat surface and

covered over evenly with a coating of glue, taking care not to leave any lumps on the sheet. The other sheet is placed over this and smoothed down by the hand, so as to exclude any air bubbles that may have formed. The second sheet is next glued in the same manner as the first, and both are placed, glued side downwards, on the tympan sheet, entirely covering the impression thereon. If the bands are wide apart it is better to put on the blotting in two separate slips. A little French chalk is dusted on the blotting, the press is closed up slowly until the impression stands on the centre, and allowed to remain in that position two or three minutes. When opened a perfect matrix will be found on the tympan sheet.

Impression answering to several sheets is next reduced, the superfluous blotting cut away, and the outer edges of the matrix pared away, so that no sharp line appears on the finished work. The gauge pins being fixed, the work can be proceeded with.

This plan answers well for short runs and small formes. For a larger forme, however, the matrix might contract if fixed upon the tympan sheet, or the tympan sheet itself might warp. This difficulty can be overcome by removing all tympan sheets and securing the blotting direct on to the iron surface of the platen. Of course, in this case the impression screw would require altering to its fullest extent; and if that did not prove sufficient, it would then be necessary to underlay the forme to make up the difference.

Another plan is that of making a matrix in the same way as if preparing for stereo, only in this case no beating of the forme is necessary. When the flong, which should be equal to three sheets of blotting, is ready, lay it on the forme in the casting box, place two or three thicknesses of blanket over it, screw down tightly, and let it remain until thoroughly baked. Having obtained the matrix, allow the forme to cool thoroughly, tighten the quoins, but be careful not to alter its position in any way, otherwise the matrix will not fit. Put the forme into the machine, make ready, and, when this is satisfactory, remove the rollers. Give the matrix a thin coating of glue at the back, put its face on that of the forme, fitting it with the greatest accuracy. Secure it in this position with small strips

of gummed paper, from the matrix to the furniture, surrounding the forme. Now take off sufficient impression and close up the press. When carefully made this matrix will stand good for a run of many thousands, and there is no danger of its shrinking or altering shape in any way, for, having been baked, it gives off an impression which is clear and sharp in every detail.

When wording has to be worked in connection with the embossing a general design should be made beforehand. This should be roughly sketched on paper. The principal features of the job and the general disposition of the lines having been decided on, the type lines may be sketched in black ink and the embossing in coloured crayon. This provides a good plan for the compositor to work to. When the forme is composed and ready for press, pull a few impressions in a pale blue tint, just sufficiently strong to be visible, on four-sheet Bristol board. On one of these can be drawn a perfect sketch in outline of the proposed embossing, filling in the parts between until they appear solid. When the sketch is finished the embossed design will appear white, the remainder black. From this sketch a zinco can be made, etched rather deeper than usual and on extra thick zinc. The plate need not extend more than a pica beyond the part to be embossed. The working of the job can be proceeded with while the zinco is being prepared, but the embossing must not be done until the work is dry. Any of the methods given above for preparing the tympan may be adopted.

The following cardboard method of embossing will be found to be an easy and quick plan for large type and panel work. It will answer for a job printed on paper and not on card, unless the design is large.

When the job is ready for the press, run it off. Then, without unlocking it or disturbing it in any way, take an impression on Bristol board, with plenty of margin so as to fasten it by the corners to a flat surface, the thickness of the card to equal the depth it is intended to emboss. Then cut accurately, at a slight angle inwardly, through the letters on subject on the card, with a thin sharp chisel, about $\frac{1}{16}$ inch wide, such as engravers use. Save what is cut out, as this makes the male die. The card with the parts cut out is the

female die, and must be glued thoroughly on a smooth block or plate, and made a little less than type high; or else take down the impression screws. When this is done, put each one of the letters or characters back in the female die from which it was cut, with glue or paste at the back of each, and then place another piece of card on top of these letters. When dry, lift the card and the letters will stick to it. This makes the male die. Then cover the face with tinfoil; or, dust with a very little french chalk while using.

When ready to emboss, lock up the female die in the chase, and take off the rollers. The packing should consist of two sheets only of good strong paper, put on in such a way that it will not move. Put glue or strong paste on the back of the male die, place in female die, and then put the forme in the press. If the chase does not fit tight push it up to the right side. Bring the platen up with enough pressure to fasten the male die to the packing. When dry, run the platen back, and adjust the impression to the sheet to be run. Set gauges, and paste the first packing sheet to the platen and the second to the first, so that it cannot move while running.

If desired, an electrotpe can be made from the female die, and the backing or male die made from leather.

The following method of embossing is suitable for ordinary soft and somewhat tough paper, but not for cardboard. The method is that by which the examples given in Earhart's "Colour Printer" were produced.

The work was done from intaglio borders, which were locked up in the chase ready for press. The forme was made ready, so that the impression showed firmly and evenly on the tympan without the use of ink. Then a paste was made of Barytes powder and a good flour paste, thoroughly mixed in equal proportions, the flour paste being free from lumps. The face of the forme was well oiled, so that when the impression was taken the pasted sheet would not stick to it. The paste was spread evenly and thinly over the impression on the tympan with a stiff brush, and a sheet of manilla tissue laid over this, and an impression taken upon it. This impression was again coated thinly with the paste, care being taken to put the paste where it was

most needed, and another sheet of the tissue added. This operation was repeated until every part of the work was embossed as evenly as the plate or border would allow. The matrix so made was dried with a hot iron or a piece of burning paper. In the meantime, at intervals of a minute or two, a half dozen impressions were taken on the tympan so that the matrix would not warp or shrink out of position while being dried. After the matrix was thoroughly hard and dry, the guides were set and the sheets run through at a moderate rate of speed.

Many fine effects may be produced by embossing and printing the borders at the same time.

Baker's Process. Embossing plates are now largely made by utilising Baker's patent transfer paper. This is a special transfer paper holding a layer of soft brown waterproof composition. An impression of a type forme picks up the brown composition from all points touched by the surface of the type. The design thus made upon the transfer paper is then transferred to the surface of a sheet of zinc, and the metal is exposed to the action of Baker's zinc etchant solution. This remarkable chemical product quickly eats away the metal not covered by the brown composition. In twenty minutes sufficient depth is sunk for all ordinary embossing purposes, such as catalogue covers and note paper headings. If for cardboard, or very stiff material, the plate is further exposed to the action of the etchant for about fifteen minutes. The same process answers for brass and steel dies.

All embossing plates should be mounted on metal. A good mount can be made by casting a plate a pica lower than type-high, using old type metal, or stereotypers' metal. Common wide bar-iron is also available. This can be had from all iron workers. By judicious selection a piece flat enough for this purpose may be severed from flat iron bars from one inch to twelve inches wide, and three-quarters inch thick.

The embossing plate can be fixed to the metal in the following manner:—Smear a piece of common printing paper both sides with molten pitch as evenly as possible, place the paper so covered between the mount and the plate, and press in a hand press. The plate will then hold for a long run. Before placing the covered paper, it is as well to heat it to make the

pitch quite soft. Guttapercha dissolved in benzine or turpentine may be spread upon the common printing paper and left to dry. This can be stored and is always ready for use. The pitch-covered paper is difficult to store, because of the "running" nature of the pitch. All the sheets stick together on any exposure to heat. Of course the guttapercha covered paper must be heated before placing between die and metal mount.

Counterparts. In addition to the counterparts described elsewhere in this chapter, sealing wax, celluloid, and india-rubber may be mentioned. Sealing wax counterparts are good all round ones, being suitable for thick or thin material—cardboard or paper. The sealing wax is manipulated in the following way:—Place the die upon the machine and pull an impression on the tympan. Spread sealing wax over the impression by means of a heated knife blade, and whilst the wax is still plastic close the machine. After opening the machine the wax will be found to have penetrated every depression. The die should be moistened, or french chalked, in order to prevent the wax sticking to the die. If the wax is of the best quality the work may now be proceeded with, but if common bottling wax is used a sheet of tissue paper, or tinfoil, should be placed over the plastic wax previous to pressing into the die. As a precaution it is best to cover the face of the counterpart with gummed paper. Moisten the gummed side, place the moistened side upon the face of the counterpart, and pull a few impressions. This gives the protective lining. Counterparts thus prepared last for a long run.

To make celluloid counterparts requires some heat. The procedure is as follows:—Take a piece of flat metal and heat it until it fizzes upon the application of a wetted finger. Place it in the bed of a hand press, or copying press. Now cut a piece of celluloid to the required size and place it upon the hot iron plate and put the die face downwards upon the celluloid. Now press. Considerable pressure is needed. The heat will make the celluloid plastic. The pressure will force the plastic material into the most minute depression, perfectly filling the die. If too much heat there is danger of explosion, or of the celluloid burning to ashes. The celluloid for large dies should be about a pica thick, for smaller ones

about a nonpareil. Few substances are more durable than celluloid for counterparts. With fair play it will last as long as a brass die, and is suitable for the toughest paper and card.

A sheet of india-rubber, about a pica in thickness, placed underneath the tympan sheet forms a resilient backing. It is very useful for many purposes, and its value is largely overlooked. It is specially useful for large dies with open work or large letters, and is also very suitable for small dies.

The above methods have been found entirely satisfactory after prolonged experience. The counterparts may, of course, be made for any sort of die with intaglio designs, whether hand engraved or etched.

Embossing as a means of heightening the effect of decorative printing is coming into more general use than formerly, and when printers understand how easily and inexpensively it may be produced, it is sure to be even more largely adopted.

The subject of embossing is obviously much too extensive to be adequately dealt with in this chapter. Readers desirous of making use of this exceedingly useful aid to effect would, therefore, do well to acquire a practical guide to the process, one of the De Montfort Press publications, entitled "Embossing, Blocking and Die Stamping."

CHAPTER XXVIII.

GOLD PRINTING.

UNDER this heading two separate processes of printing may be dealt with—(1) bronze printing, and (2) printing with gold leaf or with dutch metal. Bronze printing is, of the two, by far the more extensively practised.

The work consists of three processes:—

1. Printing from the forme with a preparation to which the bronze will adhere.
2. Applying the bronze.
3. Wiping off the superfluous bronze.

The second and third processes are usually now done by special bronzing machines, Home Office regulations having ensured the necessity of machine bronzing.

GENERAL NOTES ON BRONZING.

The essentials of success in bronze printing consist in having proper gold preparation, a good quality of bronze, and well-finished paper. The gold preparation is a size with which an impression is printed on the paper; the bronze is then dusted on to the paper, and it adheres wherever there is preparation. The superfluous bronze is afterwards rubbed or cleaned off.

Gold or Bronze Preparation is sold by all printing ink makers, and it is preferable to buy it ready made. The following is a recipe which may be useful when the manufacturer's preparation cannot be obtained:—Take equal parts of brown lake and chrome yellow. Add to them about one-tenth their weight of middle tint varnish, and about one-twentieth of extra strong litho varnish; mix well together. This preparation does not fill in the fine lines of the type; it works free and clean, and will be found to answer well on various kinds of paper. Having mixed the ink thoroughly, it should be worked up a little at machine.

Making Ready and Printing. A press or platen machine is the best for bronze work.

The forme may now be made ready. Four sheets of printing paper, with a cardboard underneath, form a good tympan packing for a platen machine.

For making ready ordinary ink should be used, for the bronze preparation used for printing dries rapidly on the stone and the slab if kept standing.

Any low types or rules in the forme should either be changed or underlaid—not overlaid. If this is done, a perfectly flat and even impression should be the result.

The impression should be as light as possible, yet firm, as it is difficult to get the bronze out of the depressions of a heavy and deep impression.

Rollers that are new, fresh, or “green” should never be used for working the preparation. A roller that is free from damp, well matured and firm, is best for the purpose.

No more ink or preparation than is required to cover the forme thoroughly should be kept on the rollers. Too much will cause the fine lines to look thick, and the job generally to have a blurred or smudgy appearance. Too little will prevent the job looking even and solid; the bronze will not hold properly, and what little does adhere will lack brightness.

The Bronze. Bronze powders are made in a variety of shades and colours. They are also of different degrees of fineness. Some are as fine in grain as flour; others are much coarser. In selecting the bronze to be used, attention must be paid to the paper on which the job is to be printed.

Fine bronzes of good quality are the cheapest to use, as they go so much further. In using a very fine bronze, however, it is necessary to apply it to the surface with great care. Otherwise it has a tendency to blacken the paper, which, of course, is prejudicial to the appearance of the work. Even when it does not produce this black effect, a very fine bronze often adheres to the paper where it should not remain, and spoils the work. If fine bronze is used, for instance, on a hard and highly glazed surface, such as an ivory card, it will cling to it, and perhaps so retentively that it cannot be removed. In a case of this kind the remedy is to use a coarser kind of bronze.

This difficulty is not met with in using enamel papers, as the coat of enamel which the paper has received, and the subsequent preparation it has undergone, have filled up the irregularities on the face of the paper, and produced a smooth surface, from which it is possible to wipe off even the very finest quality of bronze.

If it is desirable to give a last working in gold over colours, coarse grained bronzes are to be preferred, as they are not so liable to adhere to the colours as a fine bronze.

For paper of a soft nature and porous surface, a coarse grained powder should be used, which will not so easily sink into the texture of the paper.

Much depends upon the paper or card used. For an ordinary rolled paper of average hardness, the gold preparation supplied by the makers is all that can be desired. On softer papers many of these preparations are absorbed so rapidly that the work has not a solid appearance. It is found, too, that after the preparation is supposed to be dry, the gold sometimes rubs off.

It is barely possible in fact to make a gold preparation which will suit all classes of paper.

If a soft, unenamelled paper has to be worked upon, a preparation may, for instance, be made of equal parts of middle varnish and of the gold size prepared for printing purposes. This will dry, but very probably it will be absorbed so rapidly into the soft paper, before adhesion takes place, that when dry, the bronze may be rubbed off the sheet. To prevent this, a couple of ounces of strong or middle varnish, and one ounce of gold size might be used.

Although Home Office regulations restrict the use of the handy method of hand bronzing, the process may be described as of possible service. For conveying the bronze to the printed sheet, use a piece of cotton wool rounded off into a convenient sized pad. It should always be large enough to fill the hand. When putting on the bronze let the hand lie open and nearly flat on the pad.

The wool should be dipped into the powder and sufficient carried away to cover the job. Pass the pad lightly over the printed surface until all is covered; then with a little firmer pressure go rapidly several times over the same surface.

This will burnish the gold and improve it. Change the pad frequently, as the wool contracts a certain degree of dampness from its contact with the ink, and this materially affects the lustre of the bronze.

In the manner of using the pad some discretion is needed. If the forme is simply one of type, give the pad a circular movement when laying on the bronze. For brass rule move the pad along the lines, not across them. If rules run both ways let the pad be worked from left to right and from top to bottom. This will keep the lines clear and fine.

The bronze should be applied as soon as possible after the impression is taken. The printer should not be allowed to get many sheets ahead of the bronzer.

As a surface for bronzing upon, a large enamelled card, very highly glazed, may be used with advantage. There may be used instead a box, lined upon the bottom and around the sides with zinc, with a glass top. On one side there should be sufficient space to admit the hands and to allow the sheet to be placed in easily. This method, though somewhat slow, prevents the bronze flying in all directions.

It is important to discriminate between the various classes of paper or card used. On ordinary writing paper the ink or preparation dries slowly, but on enamel or the "art" papers it dries quickly. All enamelled surfaces have a tendency to absorb the preparation, and unless the bronze is dusted on quickly it will look patchy, and fail to hold properly. Enamelled papers and cards should be dusted as soon as they leave the printer's hands. The machine should be run more slowly than usual, and the forme may be double-rolled for each impression. If a large surface has to be covered two persons may be kept at work, in order to keep pace with the machineman.

Gold immediately attaches itself to any moist spot on the sheet. Hence great care must be taken to avoid leaving finger marks while bronzing. A bit of gummed paper on the finger tips of the left hand will be of service. The machineman should also rub his hands occasionally with french chalk.

As the sheets are bronzed let them be placed in piles of fifty or one hundred, and left in that position until dry. They

can then be cleaned without any fear of smearing or scratching the gold. An old silk handkerchief makes a most effective duster; or a piece of wadding may be used. It should be turned over and pulled loose at about every dozen sheets, or it will cause blacks and smudges.

The bronze may be applied by a bronzing brush or by a bronzing machine. When the latter is used the bronze is both laid on and the surplus cleaned off by means of plush or felt rollers. The brush acts on the same principle; the bronze is placed in a box at the top of the brush and allowed to sift through small holes.

Bronze work is much improved by running the sheets through a hot rolling machine, whereby the gold is burnished. Where this is not practicable the forme may be made perfectly clean and dry, and the sheets may be fed through the machine or press again after bronzing. This will fix and flatten the bronze and slightly burnish it.

The bronzing of a job should always be done before any other colour or colours. This is done to avoid any risk of the bronze catching up or adhering to any other colour that may have to be worked. It is also done to prevent the bronze hiding or covering any portion of the work it might happen to print over, as in many cases bronze is used as a ground work, and the outline coming over it gives it shape and form. If, on the contrary, the bronze came over the outline the latter would be completely covered, and anything over which it was worked would be rendered invisible.

Gold and other bronzes are often used for making panels, on which letterpress in black, etc., is afterwards printed. The work is attended with difficulties, as the black is not always solid. Concerning this, Mr. Robert Grayson explains that care must in the first place be taken to obtain a plate of good quality for the gold panel. One made of metal and perfectly free from small holes would suffice, but a ready mounted zinc plate, cut to the required size, is the best for the purpose. It costs but a small sum. Boxwood blocks and composition tint plates are not so suitable, especially if long numbers are worked, as the frequent cleaning that is necessary causes their surface to wear rough.

The bronzing preparation must be one that dries well when

covered with gold, but does not dry so quickly as not to allow sufficient time for the bronze to be carefully laid on. The only ink that prints solid black on gold at one impression is blue black. There is difficulty in getting the work to look sufficiently black and solid without overloading the forme with ink. The whole process is slow and tedious, and one that cannot be hurried. The forme, if a fairly solid one, showing large masses of black, should be double-rolled, and the machine run very slowly—so slowly, indeed, as to allow the machineman time to peel the sheet from off the forme for every impression. This may be done easily by moving the grippers clear of the sheet, and allowing the latter to adhere to the forme. A quick grip of the sheet with both hands just before the rollers descend will suffice to peel the sheet from off the forme, and most effectually prevent the “lifting” or “tearing up” of the gold surface, which must inevitably result where grippers are used to pull the sheet away quickly from the forme. This method of peeling also applies to the printing of the gold forme. Of course, never attempt to print a solid colour on gold until the latter surface is thoroughly dry.

Silver printing is done in the same manner as gold or bronze printing, but to produce a satisfactory effect more care is required. It is the custom in many printing offices to add a little blue ink to the preparation used; avoid using too much.

In estimating for bronze work, the printer must take into account not only the value of the bronze used, but other special items of cost. These arise from the expense of cleaning up the machine in order that the particular preparation may be used, instead of ordinary ink; the slow speed at which the work is done; the extra help which is necessary for dusting on the bronze; and the time occupied in finally dusting off the sheets. Work of this kind is often a source of loss owing to these items being overlooked or underestimated.

Metal Leaf Printing. The process of printing in leaf metals, such as gold (real and imitation), silver, aluminium, and copper, is somewhat similar to that of printing with bronze powders.

The metal is supplied in pieces of extreme thinness, interleaved with paper, like a thin pamphlet. The books are generally about three inches square, but the metal may be beaten in various sizes, square and oblong. Imitation gold in every way resembles real gold, but tarnishes after a time. The operation is best done at an ordinary hand press. The roller should be sharp and tacky, and the forme perfectly clean. A preparation of adhesive gold size is used. This is well distributed and rolled over the forme. An impression is pulled, and then the leaf metal is placed upon it, being carefully pressed on with the hand or a soft cloth. A nip in the press or a run through hot rollers will improve the work. When dry or set the superfluous gold is brushed off with a soft brush.

The success of the operation largely depends on the proper regulation of the size used.

The gold leaf is cut to the size required on a small leather cushion with a palette knife; or when large numbers of impressions have to be done the gold may be cut in the book with the guillotine. The leaf is manipulated with a small portion of cotton-wool slightly oiled.

Gold, Silver and Aluminium Inks. After many attempts to provide the printer with an ink to give the effect of bronze, well-known ink makers have succeeded in making a medium which carries bronze suitably and to such extent that the combination of bronze dust and varnish medium may be worked as an ink. The obvious advantages of this have encouraged makers to persevere, whilst the factory regulations restricting the use of bronze on health grounds gave a considerable impetus to their efforts and to the demands of printers requiring bronze or gold and silver effects. The ideal bronze ink will work readily, cause little trouble to rollers or in washing up, and dry with a true bronze effect. Various inks are now offered aiming at this desideratum and meeting with more or less uniform success.

CHAPTER XXIX.

MANUFACTURE OF PAPER.

IT is not necessary that the printer, as such, should be practically acquainted with the processes of the art of paper making, but he ought to possess a general knowledge of the subject in order to understand rightly certain terms of common occurrence in the press room and the warehouse.

The Raw Materials of paper are linen, jute, cotton rags, esparto (a rough and wiry grass, grown chiefly in Spain and Algeria), wood, and straw.

Rags are used for some of the best qualities of paper on account of the evenness and strength of their fibres. Cheaper kinds of paper are made from a mixture of rags and esparto. Printing papers are also made from esparto and chemically-prepared wood; paper for cheap newspapers is made entirely from wood. This latter is in fact the most largely consumed of paper-making materials.

Conversion of Raw Materials into Pulp (or "Stuff"). When rags arrive at the paper mill, they are sorted and cut into small pieces, and at the same time care is taken to remove from them any buttons or other adjuncts which fitted them for clothing. This work is done by women, and each worker has in front of her a table and receptacles into which she can sort her rags as fast as she can cut them into pieces. The cutting is done by pulling the rags across an oblique knife which projects from the surface of each table or work-bench. In some mills the rags are cut into small pieces by a cutter with revolving knives.

The rags are next placed in a huge rotary boiler, when they are boiled and bleached in a solution of lime and caustic soda. The bleaching is continued in the washing engine, where a continuous stream of water carries off the dirt, and after a further washing in water, the pulp is again cut up and reduced in a machine called the "beater." In this engine

the pulp is prepared, by the hand or machine method, by the additions of other qualities of pulp, of clay, etc., to form paper of the kind or quality required. Here, too, the size—which is a soap composed mainly of resin and alum—and the colouring matter, if required, are added.

In respect to esparto, the bales of grass, when opened, are shaken and dusted, to get rid of sand and other substances. The grass is placed in a large iron cylinder, where it is whirled swiftly round by a toothed drum. The dust is sucked downwards by a powerful fan through an opening in the bottom of the cylinder, and the grass is automatically passed out and up an inclined plane.

The grass is then put into boilers, along with a solution of caustic soda, at a pressure of 10 to 40-lb. to the square inch. It is here boiled until quite soft.

The boiled grass is next put in boxes or barrows, and taken to the “breaker.” The breaker, or washer, is an enormous vat, or engine, of a peculiar shape. The mass of softened grass is kept in a continual rapid movement. It passes a revolving cylinder, or paddle-wheel beater, by which the small pieces are gradually cut up and beaten into a thick pulp. The constant stream of water, entering by a pump, goes through the mass, and the revolving sieve, called a drum washer, allows the water and dirt to escape by a waste pipe.

From the breakers the pulp flows into a lower set of engines called the “potchers.” Hitherto the pulp is of the natural colour of the grass, but in the potchers it is bleached by a mixture of chloride of lime and chlorine. When the bleaching agent is washed out nothing remains but fibre and water.

The pulp is next taken to the beating house. It is now so fine and white that a little of it placed in a bowl of clean water dissolves, and when the bowl is shaken the water assumes the appearance of milk. It would require a microscope to distinguish the minute atoms into which the grass or rags have been reduced. The beating is of the nature of a powerful churning, and its object is to free the pulp of the chlorine, which otherwise would give the paper when dry a yellowish tinge. It has a yet further object. The natural colour of the paper, freed from the chlorine, would be a

light-green neutral shade instead of white. To prevent this a very little ultramarine blue and cochineal is put into the pulp and thoroughly churned up with it in the beating engine.

The pulp is now led by a pipe to the stuff "chest"—an enormous circular vat, some 9 feet deep by 12 feet in diameter. This is simply the reservoir in which the pulp is stored till wanted. The pulp is kept in solution by a continual agitation. It is now ready for the machine, which is to convert it into paper. As the pulp is needed, it is pumped into a smaller chest, elevated over the head of the machine. The latter is a complicated arrangement of small rollers and cylinders of various sizes, extending to a considerable length.

The pulp is poured into the head of the paper-making machine in a thin watery stream. By the turning of a handle the flow of pulp can be so regulated as to determine at will the weight or thickness of the paper.

In the machine, the pulp, after flowing down on to sand "tables," passes through strainers that purify it from any infinitesimal atoms of hard substances which may have escaped it thus far. It flows on to a float frame, or cloth, of very fine brass wire that is moving continually forward on rollers. This endless wire has a shaking motion, and allows the water to escape, while retaining the fibre evenly spread out. The wire, carrying with it the residuum of pulp, passes under the dandy roll—a cylinder coated with fine wire which presses on the pulp and gives it the "watermark". Although in a limp and almost pulpy condition, it is now paper.

The paper is next passed between a pair of couching rolls, which press it still further, and it issues forth for the first time a self-supporting endless sheet. It next goes between press rolls, and gets the water still further pressed out. After this it goes over and under a series of cylinders, heated by steam, which rapidly dry it. Then it travels between two intermediate rolls, and then over a second set of drying cylinders. It now goes through the calender—a series of chilled iron rollers that give it a surface. From the last of these rolls it is wound up in the form of a reel, which may be four miles in length. It is now almost ready for the newspaper printing office.

For papers that are of a higher quality and are not to be

printed in the reel, further treatment is necessary. If extra finish is required, the reels are taken to the super-calender, where both sides are glazed by great pressure and heat. The reels are then cut into sheets. These are taken to the finishing house, where each sheet is examined, and faulty ones thrown out. The sheets are then counted into quires or reams, and packed.

Paper Making by Hand. The details already given apply to machine manufacture. Some of the highest class printings and account-book papers are still made by hand.

The appliances are few and simple, consisting of a vat to contain the pulp, with a steam pipe or other appliance for the introduction of heat, and an agitator to prevent the fibres from settling. There is also required the mould—a frame of wood, with parallel wires about an inch apart, across which at very close intervals runs another series of parallel wires. These leave their impression on the soft pulp, producing the “water-marked” lines of a laid hand-made paper. Wove papers are produced on a wire of woven mesh. The vat-man, standing at the vat, takes in his hand the mould and a wooden frame called the “deckle,” which, when laid upon the mould, forms with it a shallow tray of wire. He dips the mould and deckle into the vat at a certain angle, and takes up just sufficient pulp to form a sheet of paper of the weight he is engaged upon. This is a very delicate and clever operation, for there is nothing to guide him as to the thickness of the paper except his own sense of feeling. His experience and practice, however, enable him to make sheet after sheet with a variation of not more than a grain or two between them. He shakes the mould first from his breast outwards, and back again; then from right to left, and back again. By these movements the pulp is propelled in four directions, and the fibres thereby caused to interweave or to “felt,” the water meanwhile escaping both through the wire and over the edge of the deckle. The mould and the new-formed sheet are next passed on to a board, and the deckle removed. An assistant, called the coucher, removes the mould and sheet, and turns it upside down on a piece of felt, to which the paper is transferred. When about half-a-dozen quires of paper are thus made, with felts between each sheet, the pile is taken to a

press, and compressed. A boy, called a layer, separates the sheets from the felts. The latter are returned to the coucher, and the sheets go under the press again, remaining there all night, with the view of getting rid of more of the moisture and removing the felt marks. On the following day the paper is again separated and pressed. The sheets are next dried over cow-hair ropes in a room which is known as the "loft"; hence the term, "loft-dried paper." Sizing is the next operation, to perform which, the sheets are passed in small batches, spread loosely upon each other, through a long trough containing a gelatine solution. Prior to this process the sheets are in an absorbent state, but after the passage through the gelatine, followed by loft drying, they are perfectly impermeable to ordinary fluids. Before this sizing it is as absorbent as blotting paper. The sheets are again dried, and glazed and sorted, the "perfect" sheets being counted into reams.

CHAPTER XXX.

VARIETIES, ETC., OF PAPER.

Distinguishing Hand, Mould and Machine-made Paper. The printer often finds it difficult to distinguish between these three classes of paper, so closely do they resemble each other in general appearance. The principal distinguishing characteristics may be summed up as follows:—

Hand-made and mould-made papers have rough or “deckle” edges. Imitation hand-made papers also have rough edges artificially produced.

Hand-made writing paper is darker in colour on the right side than the wrong. Machine-made is darker on the wrong. In some mills, however, colouring is applied so that this test is unavailable.

Should there be a sort of watermark on one side of laid papers they are machine-made.

Machine-made paper tears with more difficulty and with a rougher edge one way than another. Hand-made paper tears the same both ways.

In machine-made papers the majority of the fibres run one way; in hand-made and mould-made the fibres run in all directions.

In hand-made paper the wiremark is on the right side and in machine-made on the wrong side of the paper, but in each case the impression of the watermark is on the right side.

Right and Wrong Side of Paper. Most papers, apart from those of the “duplex” and coated variety, have two different surfaces, which are known as the wrong (wire side, or inferior) and the right (or best) sides. If printing, especially job work, is done on the wrong side it is usually deficient in sharpness, clearness, and solidity, added to which more ink is consumed.

The first test for the proper side of a sheet is roughness of surface. The smooth side is nearly always the right side.

Another test is a difference of colour between the two sides.

Azure-laid, yellow-wove, or blue is, if machine-made, darker on the wrong side ; if hand-made, the right side is the darker.

The wrong side of the machine-made paper usually shows the mark of the web or wire gauze over which the paper travels while in a pulpy state, the right side being smooth and having more finish. In hand-made and mould-made papers the wire side is the right side.

In writing paper the watermark will be a guide. The design appears reversed on the wrong side.

If the ream of paper be flat, the right side is uppermost when the ream is opened. If the paper be folded, the outside is the right side.

Wove Paper is paper that appears as if it were woven; it presents the appearance that calico does on looking through it.

Laid Paper has the appearance of being ribbed.

These two papers differ only in the watermark. The same "stuff" may be made into either wove or laid paper by the dandy roll, the travelling wire upon which the sheet is formed playing no part in the creation of the wove or laid appearance.

Plate-glazed Paper is finished by being placed sheet by sheet between copper or zinc plates. When a convenient quantity has been thus prepared, the pile is pressed through powerful rollers. According to the degree of finish to be given, the paper is repeatedly rolled, changing the position of the sheets occasionally to avoid flaws in the plates.

Machine or Mill Finish is the ordinary finish imparted by the calender rolls.

Tub-sized Paper is paper which has been sized after being made. Most kinds of hand-made papers are tub-sized with animal size, consisting of gelatine or size made by boiling strips of parchment, etc. The sheets are dipped into a tub of size, and afterwards dried—hence the name tub-sized. Except for the very highest qualities, tub-sizing is now performed on the web or reel of paper.

Engine-sized Papers receive their size, consisting of resin precipitated by alum, while still in the state of pulp in the beating engine.

Tub-sized papers have a much harder and more impervious surface than engine-sized papers, while the tear of the sheet is much more tough.

Art Papers are a class of papers which came into use during the development of half-tone blocks. They have an exquisitely fine surface, obtained by coating them on one side or both with a mixture of clay and glue. Calender rolls confer an absolutely even and smooth surface. Hence they are adapted for the fine detail constituting half-tones.

Duplex Papers have a different colour on each side. They are highly glazed and coated papers.

Retree Papers are those which are deteriorated by faults in the process of manufacture, such as dirty spots or specks, pinholes, and slight stains. Perfect paper is known in the trade as "good," and the retree sheets have been removed from such reams.

A mark thus "× ×" on the outside of a ream indicates that it consists of retree. If there are three crosses "× × ×" the paper is known as "broke," and contains more serious faults.

It is usual to place the folded sections of good paper back to back alternately in the ream. If the sections are alternated every other two the ream is retree.

Buying Paper. The present customs of the paper trade, as they affect printers, have been defined by a code of rules adopted by the Paper Makers' Associations of the United Kingdom. They are as follows :

Paper is bought by the printer either at a price per ream, based upon its nominal weight, or at the actual weight by the pound, packed in reams or in reels. Wrapping paper is bought by the hundredweight at scale weight. The weight of necessary wrappers and string for reams and reels is included in the chargeable weight of paper.

Machine-made Papers. A ream of paper, unless otherwise specified, contains 480 sheets. (Manufacturers are now gradually adopting the long advocated uniform 500-sheet ream).

An "inside" ream contains 480 sheets "all insides," i.e., 20 good or inside quires of 24 sheets each.

A "perfect" ream for printing papers contains 516 sheets.

A ream of envelope paper contains 504 sheets.

A ream of "news" contains 500 sheets.

A "mill" ream contains 480 sheets, and consists of 18

{ “good” or “insides” quires of 24 sheets each, and 2 “outsides” quires of 24 sheets each.
 Reams are classed as “good,” “retree,” and “outsides.”
 The price of “retree” is ten per cent. and of “outsides” twenty per cent. lower than that of “good.”

Hand-made Papers. A “mill” ream, “good” or “retree,” contains 472 sheets, and consists of 18 “insides” quires of 24 sheets each, and two “outsides” of 20 sheets each.

An “insides” ream, “good” or “retree,” contains 480 sheets, and consists of 20 “insides” quires of 24 sheets each.

In all cases the “outsides” quires are placed one at the top and one at the bottom of the ream.

Adaptability and Qualities of Paper. At a time like the present, when an enormous and ever-increasing number of varieties of paper are used in the printing office, it is most desirable, if not essential, that printers should learn all they can about their suitability for different kinds of work, and their qualities. Unfortunately, the printer is not in a position to test their constituents, this involving the use of chemical and microscopical apparatus, as well as considerable scientific knowledge. He has to confine himself to the strength, colour, finish, and kindred qualities which can be ascertained by touch and vision.

As a general rule, the most suitable papers for printing are those which adapt themselves most readily and fully to the printing surface, whether a forme of type or of movable blocks. The chief requirements of a good printing paper are that it should take ink easily, and retain it; that it is not very hard; and that it is of good colour and, to a certain degree, absorbent. It is desirable that there should be a complete absence of mechanical wood-pulp.

Generally speaking, the following are the most suitable classes of paper for the kinds of work mentioned:—

Book-work without cuts: the better class of printings, with a fairly good surface, and not too highly glazed.

Book-work with cuts: imitation art paper, or any of the various makes of coated papers, the latter being preferred.

Commercial jobbing: the cream laid and wove writings, antiques, banks and bonds.

Fancy circulars : duplex, coated and tinted antique papers are popular.

Loading is an addition to the pulp of some mineral substance, such as clay. Its purpose is to fill up the interstices between the fibres, thus enabling the paper to take on a better and more absorbent finish for printing purposes. Used in excess it may be regarded as an adulterant. It may be detected by incinerating some of the paper, and noticing the residue or ash. The percentage of loading may be found by weighing the paper before burning, and the residue left afterwards.

Hard and Soft Paper. The hardness of a paper depends partly upon the manner of beating but chiefly upon the fibre that is used. Cotton is the best for printing paper, and finer grades always contain it as the principal ingredient. Esparto grass and chemical soda wood-pulp also produce excellent printing papers at a more popular price. The sizing of paper during the process of its manufacture also very materially regulates its hardness or softness. A highly-sized paper is hard, and the ink does not soak into it; an under-sized paper is soft, and absorbs the ink. A soft-sized paper, when written upon, allows the writing ink to run and show through the paper. Hard paper allows the ink to remain on the surface, and is a long time in drying. Hence paper may be tested for hardness or softness by writing on it with a pen and ink, or by printing upon it. Another test is to moisten a small portion with the tongue. If the paper is hard the moisture and ink will be some time in drying, and if soft they will be absorbed quickly.

Paper for fine printing should be moderately soft-sized, well rolled or calendered, to give a perfectly smooth surface, and made of good material, without an undue quantity of clay.

In *Art Printing Papers* the chief qualities to be looked for, in addition to the finish of the surface, are the durability of the colour when exposed to light and air, and the degree of stretch which it allows when damp and of contraction when dry. Strength in such a paper is not of great importance. Papers of the better kind ought to be free from material which will in time cause them to turn yellow, especially at the edges. This is always a danger in using a paper of which mechanical wood-pulp forms a constituent. It is most

essential to ascertain before purchasing if book papers have a permanent colour, and are free from this material.

Super-calendered Paper with a polished surface is very popular for various reasons. Its smooth, finished surface takes a better impression than paper of an opposite quality, and with less ink. Being close in texture, a stiffer ink can be used without fear of peeling or filling up blocks or formes. The fine surface being given by continued pressure, the paper has a much more even texture throughout than ordinary paper, making it more suitable for fine work. Ink lies upon a glazed surface instead of sinking in, and this quality produces a greater density of colour. The exceptionally glossy appearance of some publications is more owing to the excellence of the surfaced paper than to the density of the ink used.

The Strength of Paper. Wholesale stationers and paper makers have delicate appliances wherewith the strain which a piece of paper will bear is exactly indicated. These are not used by many printers, and indeed the matter of strength is not, as compared with that of surface, of much general importance. Some kinds of commercial printing, however, require paper which will resist wear and tear, and the printer ought to be able to apply tests for ascertaining this quality.

Tearing conveys an accurate idea of the strength of paper, but must be performed both ways of the sheet, and again diagonally. The strength of machine-made paper differs to the extent of about twenty-five per cent. between the cross and length way of the web.

Another test is that of folding the sheet backward and forward and then examining the creases. This gives some idea of the materials used. For instance much loading in a paper deprives it of resistance to crumpling, and the quantity of dust which the folding produces suggests how much adulteration has been introduced. Some papers are extremely brittle when thus treated, and thereby quite unsuited for certain jobs.

For ordinary purposes the test of resistance against crumpling and friction is the most useful. Half a sheet of paper may be crumpled up into a ball, again smoothed out, and the process repeated several times until the sheet is full of small wrinkles. Papers possessing small resistance to crumpling will, by this treatment, at once show holes. The wrinkled

paper is next taken and rubbed between the palms of the hands. With a little practice in this direction it will not be found difficult to detect the strength of the paper.

Another test is that of holding the paper by each hand at two of its edges and violently jerking them apart. Some papers tear when a very slight strain is thus put upon them; others withstand it to a greater extent.

Endurance of Paper. Much of the paper now used is of an extremely perishable character, especially when exposed to damp. Paper made from mechanical wood-pulp—from which the resin has not been properly extracted—is extremely perishable, and soon loses its colour, besides being injurious to type and blocks. Paper made from wood purified by chemical process is more enduring. Mechanical wood-pulp paper is quite unsuitable for printing good books. It is, however, very cheap, and its low price has made possible most of the extremely cheap books and periodicals of the present day.

Paper required for a job. It is not necessary to occupy space in this work with a table of the quantity of paper required for jobs of various numbers. A table of the kind to be of real usefulness must be a very full one, and show quantities according to the kind of ream from which the paper is to be cut. Tables of this kind are easily procurable in handy form.

A question such as “How many ‘perfect’ reams of double crown would be required for printing 50,000 single leaf crown 8vo handbills?” is worked out thus:—Take the quantity of handbills required (50,000), and divide it by the number cut out of a double crown sheet (16); this will give the number of sheets required. Divide this again by 516—the number of sheets in a “perfect” ream of machine-made paper—and the result is the number required.

In making calculations of this kind, allowance must be made for sheets spoiled in printing, etc.

Equivalent Weights. To ascertain the weights of different sizes of paper, multiply the weight of the paper in hand by the size (in square inches) of a sheet of the paper the weight of which is required to be known, and divide by the size (in square inches) of a sheet of the first-named paper.

Example—What would be the equivalent weight in double foolscap size of a 26-lb. demy?

Demy is $17\frac{1}{2} \times 22\frac{1}{2}$ inches ; double foolscap, 17×27 inches.
Multiply 26 (the weight in pounds of demy) by 17×27 , and divide by $17\frac{1}{2} \times 22\frac{1}{2}$.

The following tables, for which we are indebted to Jas. Wrigley & Son, Ltd., paper makers, Bury, will save much trouble in calculating equivalent weights.

WRITING PAPERS.

LARGE POST.	FOOLSCAP.	POST.	ACCOUNT BOOK MEDIUM.	MEDIUM.	ROYAL.
LB.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.
11	6 15	9 3	12 8	13 2	14 7
12	7 9	10 0	13 10	14 5	15 12
13	8 3	10 14	14 12	15 8	17 2
14	8 13	11 11	15 14	16 11	18 7
15	9 7	12 9	17 0	17 14	19 12
16	10 1	13 6	18 3	19 1	21 1
17	10 11	14 4	19 5	20 4	22 6
18	11 5	15 1	20 7	21 8	23 11
19	11 15	15 15	21 9	22 11	25 0
20	12 9	16 12	22 11	23 14	26 5
21	13 3	17 9	23 13	25 1	27 10
22	13 13	18 6	24 15	26 4	28 15
23	14 7	19 4	26 2	27 7	30 4
24	15 2	20 1	27 4	28 10	31 9
25	15 12	20 15	28 6	29 13	32 14
26	16 6	21 12	29 8	31 1	34 3
27	17 0	22 10	30 11	32 4	35 8
28	17 10	23 7	31 13	33 7	36 14
29	18 4	24 4	32 15	34 10	38 3
30	18 14	25 1	34 1	35 13	39 8
31	19 8	25 15	35 3	37 0	40 13
32	20 3	26 12	36 6	38 3	42 2
33	20 13	27 10	37 8	39 6	43 7
34	21 7	28 7	38 10	40 9	44 12
35	22 1	29 4	39 12	41 13	46 1
36	22 11	30 1	40 14	43 0	47 6
37	23 5	30 15	42 0	44 3	48 11
38	23 15	31 13	43 2	45 6	50 0
39	24 9	32 10	44 5	46 9	51 5
40	25 4	33 7	45 7	47 12	52 10

PRINTING PAPERS.

DEMY.	DOUBLE FOOLSCAP.	ROYAL.	SUPER ROYAL.	DOUBLE CROWN.	IMPERIAL.
LB.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.	LB. OZ.
11	12 13	14 4	15 12	16 12	18 7
12	14 0	15 8	17 3	18 4	20 1
13	15 2	16 13	18 10	19 12	21 12
14	16 5	18 2	20 0	21 5	23 7
15	17 7	19 7	21 7	22 13	25 2
16	18 10	20 11	22 14	24 5	26 13
17	19 13	22 0	24 5	25 13	28 7
18	20 15	23 5	25 12	27 6	30 2
19	22 2	24 10	27 3	28 15	31 13
20	23 5	25 14	28 10	30 7	33 8
21	24 7	27 3	30 1	31 15	35 2
22	25 10	28 7	31 8	33 8	36 13
23	26 13	29 12	32 15	35 1	38 8
24	27 15	31 1	34 6	36 9	40 3
25	29 2	32 6	35 12	38 1	41 13
26	30 5	33 10	37 3	39 9	43 8
27	31 7	34 15	38 10	41 2	45 3
28	32 10	36 4	40 1	42 10	46 14
29	33 13	37 8	41 8	44 2	48 8
30	34 15	38 13	42 15	45 11	50 3
31	36 2	40 2	44 6	47 3	51 14
32	37 4	41 7	45 13	48 11	53 9
33	38 7	42 11	47 4	50 4	55 4
34	39 10	44 0	48 11	51 12	56 15
35	40 12	45 5	50 1	53 5	58 10
36	41 15	46 9	51 8	54 13	60 5
37	43 1	47 14	52 15	56 5	61 15
38	44 4	49 3	54 6	57 14	63 10
39	45 7	50 8	55 13	59 6	65 5
40	46 9	51 12	57 4	60 14	67 0

CHAPTER XXXI.

STEREOTYPING.

MANY printers find it advantageous to stereotype in their own offices, but in nearly all the large towns there are trade stereotyping houses who naturally do the work better, more expeditiously, and generally speaking more economically than the printer may do it. In newspaper offices where rotary web machines are employed, the plates, of course, have to be cast on the premises. This is done by a staff of trained stereotypers, and complete instructions for this branch of the business would require more space than can be here appropriated to it. For general printing offices stereotyping apparatus is available from well-known makers. Directions for the use of the apparatus are usually supplied, and as the design of these small foundries varies, instructions which apply to one may not apply to others. The following general instructions may, however, be of service.

The operation of stereotyping consists of making a matrix or mould in paper or other substance from a type forme or block, and casting from it a plate which can be printed by the letterpress method.

The printing surface is first surrounded with type-high clumps and locked up. These clumps have bevelled edges, and the bevel should be next to the forme.

The forme should next be carefully cleaned, and brushed over with an oiled brush. It is then ready for moulding.

The mould is made by using a preparation of sheets of paper pasted together called a flong. Flong is made by taking a sheet of blotting paper and pasting one side of it with a specially prepared paste, hereafter described, and placing over it a sheet of tissue paper, then pasting again, and putting on another sheet of tissue ; next, the other side of the blotting receives two pasted tissues in the same way.

Before being used, a sheet of tissue is pasted on one side and a sheet of blotting on the other. The tissue side, being the face side, is dusted over with french chalk, to prevent the mould sticking and to help the metal to run.

To make the mould, the flong is placed face (or tissue side) downwards on the forme, and beaten into the type with a long, flat brush. When sufficiently beaten, the whites and hollows need packing. Strips of cardboard—old disused moulds are best, about eight or ten-sheet board is the proper thickness—are cut to fit the various places. The forme, with the mould upon it, is then placed in the drying box, a piece of press blanket put over it, and pressure applied.

The drying box is somewhat after the form of a copying press, with an atmospheric burner underneath to give heat. After stopping in the drying box about fifteen minutes, the pressure is released, the blanket removed, and the mould allowed to stay a few minutes to dry, strips of metal being placed on the edge to prevent it curling up. The mould is next taken off the forme, all superfluous paper cut away, and put on the table of the drying box to further dry. A “lip” is pasted at one end, consisting of brown paper, and it should be sufficiently long to hang out of the top of the casting box when placed ready for casting.

Casting the plate is the next operation. The mould is placed on its back on the bottom plate of the casting box, the lip hanging out at the end of the plate. The gauges, consisting of strips of iron, a pica in thickness, are placed down each side and along the bottom of the mould, reaching to the top of the plate. A piece of paper is placed over the whole, the top plate brought down, and the screw applied. The box is next placed in a perpendicular position, and the metal is poured between the protruding gauges and papers. In a few seconds the metal is set, the box placed in a horizontal position, and the lid removed, disclosing the plate.

The mould being removed, the tang or “pour,” that is, the superfluous metal, is cut away, when the plate can be trimmed and mounted on wood. It is then ready for use.

The paste for flong may be made by taking—

Bookbinder's paste	...	...	...	...	1 lb.
Whiting (beaten to a powder)	...	...	...	...	1 oz.
Glue (melted in double its weight of water)	...	...	...	...	1 oz.
Starch	...	...	...	...	1 oz.
Powdered alum	...	...	...	...	$\frac{1}{4}$ oz.

Mix well together, reduce to consistency of thick cream, and strain through a sieve, when it will be ready for use.

To test the metal for the proper heat for casting, dip into the molten metal a piece of white paper. If the paper be scorched black, the metal is too hot; if it is turned cream colour, it is just right.

Stereo metal is not so hard as type metal. It consists, say, of 85 per cent. of lead, and 15 per cent. of regulus or antimony.

The proper thickness of a stereotype plate is the sixth of an inch, or a pica.

There are also dry flongs obtainable ready for moulding. Their use not only accelerates speed in the production of a stereotype plate, but obviates the necessity of both beating in and heating the formes of type. The process consists of a specially prepared dry flong, which is laid on the forme, and the mould is obtained by means of a cylinder impression, on a machine technically known as a mangle. The flong is used as supplied, and a mould taken by this process is ready for casting from immediately the impression has been obtained from pressure under the cylinder, and a plate can be produced, it is claimed, in two or three minutes. In the dry process machine rolling is imperative—hand beating being insufficient—and this not only adds to the cost of plant but removes obvious advantages in hand beating, particularly for small work.

Much attention has been paid of late to the improvement of methods of stereotyping, with the result that matrices wear longer, harder metal may be used, casts are sharper and capable of longer wear, and even half-tone blocks may be successfully duplicated. The Nickello process of stereotyping, for instance, permits of practically any number of casts being taken from the same matrix. With the Nickello flong a paste composition is applied to the usual paper surface, and when partially set is pressed directly on to the face of the

previously oiled forme or block. This composition sets hard and smooth as porcelain, whilst retaining the flexibility of an ordinary flong. The process is, in fact, analogous to that of moulding in wax in the electrotyping process. As a finish to the final casting from the flong, a hard coating of nickel is given to it by electrolytic means. The nickelling fills up the pores of the stereo metal, giving the cast a harder, brighter and more homogenous surface.

The application of a nickel or steel surface to stereotypes forms quite a development of its own, aiming, of course, at increasing the life and value of a stereo.

The Dalziel Hard Metal Stereo process is accepted as a valuable improvement, ensuring superiority in respect to printing qualities and in the durability of the stereo-plate thus produced.

CHAPTER XXXII.

ELECTROTYPING.

ONLY in the very largest printing offices is electrotyping done on the premises. It is an art requiring an expensive plant, and a skilled and experienced staff of workmen, so that the work is best executed by firms who confine themselves to the business of electrotyping for printers. The general outline of the processes involved in this valuable auxiliary art should, however, be understood by every printer.

Electrotyping is the art of producing duplicates of woodcuts, process and other blocks, and type formes by means of the electro deposition of copper upon a mould, usually in wax, taken from the original.

Electrotyping as carried on in different establishments varies greatly in some of its details, but the general procedure may be thus described. A moulding tray is warmed and placed on a level iron table, and melted beeswax poured into it from a ladle. After the wax has flowed quite level and become just set, it is rubbed over with black-lead and polished by means of a soft brush, after which it is ready for taking an impression of the block or page to be reproduced. To make this impression, great and steady pressure is needed, and this is obtained by means of the hydraulic moulding press—a massive iron frame having a planed bed over which is a fixed head. There is a projecting table on which the tray of wax and the forme of type, previously black-leaded and brushed, are arranged before sliding them in the press to receive the pressure, which is applied by raising the bed against the head-piece. After the press is opened, the tray and the forme of type are withdrawn and separated.

This wax impression is next placed on a table for the process of building, which consists in running melted wax on such parts of the mould as correspond to blanks in the forme. A building iron is heated and applied to a strip of wax, causing

it to melt and flow down on to the blanks. The mould is now ready for black-leading or burnishing, which is necessary to provide a conducting surface and cause the copper to be gradually deposited over every part of it. The method of automatic burnishing is to place the mould on a carriage, which runs forward and backward in an air-tight compartment supplied with black-lead and vibrating brushes which cover the face of the mould thoroughly with the powder, and the brushes impart to it a high polish. The mould is then taken to a sink and the superfluous plumbago sprayed away with water.

The magneto-electric machine has, in large establishments, been displaced by the dynamo-electric machine, or dynamo; the distinction being that in the former a permanent magnet in the shape of a cell or series of cells called a battery is employed, while in the latter its place is taken by an electro-magnet. As the current passes through the bath, the solution becomes decomposed, its copper being gradually deposited on the mould, while the liberated sulphuric acid dissolves an equivalent proportion of copper from the anode; or in other words, the copper is deposited on the mould at the same rate that it is dissolved from the anode. The mould may from time to time be raised to ascertain whether the desired thickness of copper shell has been obtained—the thickness of a stout sheet of paper. If this is satisfactory, the mould is taken out of the solution, and placed in a slanting position in a trough. Hot water is poured over the copper deposit, which melts the surface of the wax in contact with it, and the operator removes it from the mould. The shell is then backed with a soft metal consisting of lead and antimony, and is thus thickened to the extent required for use as a plate. It is finally finished by planing the back and bevelling the edges.

Many changes continue to take place in the actual electrotyping methods; but the general principles remain the same. Copper electrotypes are still deposited on to black-leaded wax moulds from an acid solution of copper sulphate by the action of the electric current, but there is a considerable difference in the plant for doing it. Instead of the old Smee batteries for furnishing the current, and thereby taking about ten to twelve hours to deposit a batch of work, all the latest

resources of dynamic electricity are employed in the more modern establishments, and it is now possible to reduce the time for depositing shells of the required thickness to fifteen minutes or less where necessary, whilst the ordinary time for turning out regular batches of work from the depositing trough need not exceed forty to fifty minutes.

1e. Red ink
Electrotypes and stereotypes are sometimes coated with deposits of certain metals, with a view of rendering them more durable, or of preventing the action of the copper on certain coloured inks. The most useful of these metals are nickel and steel.

Preparing Formes for Electrotyping. First surround the page with type-high stereo furniture, using high spaces and quads. If ordinary spaces be used, the wax will be forced too low into the type, resulting in difficulty in separating the mould from the forme. To obviate this, the forme may be "floated" in plaster of paris, which will fill up all interstices to the level of the shoulder of the type. This, however, is objectionable, because the plaster sticks in parts of the letters and much trouble is caused in removing it when the forme has to be distributed. Therefore use high spaces and quads. The mould is prized from the forme by a specially constructed chisel.

Compositors cannot be too careful to ensure that formes are absolutely squared up before finally locking up.

Special care should be taken in locking up, using foundry chases. These are chases of unusual strength, designed to withstand great pressure, and fitted with screws for locking up, instead of sidesticks and quoins. Formes sent to the foundry in ordinary chases are unlocked, and foundry chases substituted.

Where there are rule joinings, they should be firmly secured up to the shoulder, for often when the forme leaves the printer with perfect joints the intense pressure in the wax moulding drives them apart. Thus mitres are opened, and single rule is thrown out of the straight line, or made heavy on the face, unless, of course, these weaknesses are remedied by the electrotyper.

The page should be surrounded by type-high stereo furniture.

Before sending a forme to the foundry, a proof should be pulled in order to detect any low letters, any batters or picks, or anything which may have adhered to the underside of the forme.

Storage of Electrotypes. Electrotypes should be kept in a dry closet. In order to prevent the formation of verdigris vaseline may be rubbed on the face.

There are now in use various specialized systems of moulding, including the Albert lead-moulding process. Information concerning these will be found in the particular text books devoted to the trade.

CHAPTER XXXIII.

GRAPHIC ARTS AUXILIARY TO LETTERPRESS PRINTING.

IN the outline which it is here proposed to give of the principal graphic arts which are auxiliary and accessory to typography, no attempt will be made to provide practical instructions for carrying them out. The space which is available in this book would preclude such an attempt, and upon nearly all of the processes separate text books have been published. It is, however, desirable that the printer should have a general acquaintance with the nature of some of the technology of these arts, that he may understand how they are related to his own business, and what are their capabilities and their limitations. In giving orders for "outside work" this information is almost indispensable.

There are now many methods of illustration available, some of which have been practised for many years, while others have been only recently invented or perfected. These methods may be tabulated thus :—

For printing by the letterpress method—

- Wood engravings ;
- Engravings on type metal ;
- Process blocks in line ;
- Process blocks in half-tones.

From these, stereotypes may be made by the plaster or paper methods, or electrotypes. Colour printing is done from blocks of this description, the blocks being adapted for use in ordinary chromatic work or for the "three-colour" process. All the above blocks are in relief, and they can be printed on separate sheets or with type formes—the latter being a most important advantage.

For printing by the copper-plate method—

- Copper and steel-plate line engravings ;
- Etchings ;
- Mezzotints ;

Photogravures (also called Gaupil-gravure, photo-aqua-tint, etc.). These surfaces are in intaglio, or depressed, and cannot be printed on the type-press or with types.

For printing by the lithographic method—

Lithography ;

Lithographic offset ;

Photo-lithography (sometimes called ink photography) ;

Collotype (also called heliotype, Albertype, photophane, lichtdruck (German), phototypie (French). Coloured pictures are produced by variants of these processes.

These surfaces cannot be printed with type.

There are various methods for producing printing surfaces. Suppose that a drawing has been made in ink on such surfaces as copper, steel, wood, stone. A single impression could easily be got from such a drawing. For a repetition of the print, the problem is how to re-ink the lines of the drawing without inking the rest of the plate, that is, how to pass an ink roller over the whole so as to leave the undrawn-on surface clean—otherwise the result would be a mere solid space of black.

The devices that have been invented for doing this resolve themselves into two ways of altering the level of the drawing as compared with the rest of the surface.

In wood engraving the rest of the surface is dug away ; the drawing remains in relief ; the ink roller blackens only the relieved parts.

In etching and metal engraving the lines are bitten in with acid, or dug out with a tool, so that they fall below the level of the surface. The ink, at first covering the whole plate, is wiped away from the rest and left only in the furrows.

In lithography, or stone printing, on the contrary, the drawing remains, as it was made, on the surface of the stone ; the ink roller passes over drawing and blank spaces alike, touching them both, but blackening only the drawing. The parts of the stone not drawn upon actually refuse to be inked. The very drawing itself, in fact, is inked, and can be multiplied indefinitely without alteration of character at the hands of author or interpreter by being dug out of copper or carved out of wood.

Wood Engravings are made on pieces of wood called

blocks. The best engravings are always on boxwood, cut on the end of the grain. They are of the same height as type. Large blocks are provided by uniting or "amalgamating" smaller blocks by screws and in other ways. The surface of the block, being too smooth to receive the markings of a pencil, is roughened, and at the same time whitened all over with a moist powder of flake white and fine brick. When dry, the design is drawn upon the surface, being, of course, reversed. The block is laid upon a pad, and held in the engraver's left hand, while it is cut by the graver held in his right hand. Various kinds of engraving tools are used, such as gravers, tint tools, gouges, chisels, or flat tools, and a tool for scraping away or lowering the edges or other parts. Gravers are usually triangular at the end, one of the points projecting. Tint tools, used where a succession of fine parallel lines is wanted, are deeper in their sides than gravers. There are special tools for cutting out large hollow spaces. Machines for ruling are also used.

In some cases the draughtsman or artist merely indicates roughly the lines, the drawing being made with a wash. In such work the engraver has to translate each particular portion into the lines or marks which he deems appropriate. When engravings are made directly from photographs, or when photographs are made directly upon the wood, as is now very common, the same practice must be followed—all depending upon the taste, skill, and judgment of the engraver. Where there are no lines, he must devise some which will answer the purpose.

Process Blocks in line and in half-tone have been referred to in the chapter on photo-engraving.

Copper and Steel Plate Engravings are the converse of wood engravings. In the latter, the line to be printed black is left in relief, and only the white spaces and white lines are hollowed out; whereas, in plate engraving the line itself is hollowed out. This is done by means of a graving tool called a burin, which is a small bar of steel fixed in a mushroom-shaped handle of wood, with one side cut away. The cutting end, which is shaped like a lozenge, acts like a plough—it makes a furrow, and turns out a shaving of metal as the plough turns the soil of a field. The burin, however, is

pushed, not pulled. The hollows thus produced are filled with printing ink ; the printing ink is wiped from the smooth surface of the copper ; damped paper is placed upon it, and driven into the hollowed letter by the roller of the copperplate press (which answers to the cylinder of a letterpress machine). This fetches the ink out upon the paper, and the result is the copperplate print.

Etchings are produced in a very different way. The plate is first prepared with a composition which resists acid, called an etching ground. The back and edges are protected from the acid by a varnish, and the drawing is traced on the grounded surface. The etching needle is next brought into requisition. It may be a piece of steel sharpened, or even the prong of an old steel fork. This needle removes the ground and lays the copper bare. Biting-in follows, by means of a mordant consisting of hydrochloric acid, chlorate of potash, and water. This tincture causes the lines to be bitten-in, and the plate is printed as a copperplate line engraving.

Aquatints are etchings which imitate brush-wash etchings. The aquatint method is used in combination with line etching.

Mezzotint Plates are prepared, before any design is made upon them, by means of an instrument like a chisel, with the edge ground into the segment of a circle, like the rocker of a cradle, and is so engraved as to present when sharp about 100 or 120 small teeth. This cradle is rocked from side to side with the hand, and every tooth makes a small dent in the copper, and raises a corresponding bur. The whole surface of the plate is gone over with this instrument about 80 times in different directions before it is in a fit condition to be worked upon. When sufficiently prepared it presents a fine grain. The engraver removes the grain with a scraper, and in proportion as he removes it the tint becomes paler and paler. Pure whites are got by scraping the grain away entirely and burnishing the plate. The engraver has nothing to do with line, but thinks entirely of masses relieved from each other, like half-tones. A mezzotint in line is called a drypoint. The point of the stylus makes a scratch on the copper and raises a bur, which retains the ink in the printing, as the bur from the cradle would in mezzotint.

Copper, steel, and zinc are the metals chiefly used for

engraving. Steel is less employed than formerly, because copper is now covered with a coat of steel by the electrotpe process, which enables it to resist printing indefinitely, as the steel can be renewed at will. Zinc is similarly coated with copper, and sometimes used for small editions.

In *Photogravure* a photograph of a drawing is usually made on a sensitised copper plate. This is coated with some acid-resisting varnish, but when the varnished plate is washed with water or some acid, the varnish covering the picture on the plate comes away, leaving the picture on the bare copper. This is then bitten in exactly the same way as an etching.

The years 1912-13 saw a great development in machine photogravure. What had formerly been a slow and even laborious process became changed to a wonderful extent. Not merely flat-bed, but rotary presses working from the reel were brought into use, and machine photogravure entered upon a new and wide field of popularity.

In *Lithography* the printing is done from a surface that is neither raised in relief nor cut in intaglio. It is brought about in a very simple way. Water repels grease, and grease water. The ink or chalk with which the drawing is made has grease in it, and the ink with which it is printed also has grease in it. Water is applied to the stone before inking. This wets the part ungreased—that is, the part undrawn upon—so that the ink only attaches itself to the parts drawn upon, i.e., greased.

Metal engraving and wood engraving demand great skill, and introduce an art intermediary between the drawing and the printing. Lithography, however, is autographic reproduction, for nothing but the mechanism of fixing, inking, and the press comes between the act of the draughtsman and the printer. Lithography accordingly depends on the affinities and repulsions of the substances used in printing, and not on mechanical devices of sunk or raised surface. Hence its inventor, Aloys Senefelder, called it “chemical printing.”

He suggested different substances that would re-act in the necessary way towards water and grease, but developed his invention by the use of Solenhofen stone, which he hit upon by an accident. This hard, calcareous, homogenous stone,

capable of taking a polish, was in use for various purposes, for example, by leather workers to pare their leather upon. Senefelder had it in use for grinding his inks, and his first experiments were directed to employing it for etching, as a cheaper substitute for copper. No substance has yet taken its place in lithography; though much work is done from zinc, aluminium, etc. Its advantages are that it is dense in texture without being hard, it yields a smooth or an equally grained surface, so that it can be drawn upon with ink or chalk like smooth or rough paper, and that its affinities for grease and water are equal. The least touch of grease is retained with exceeding tenacity. A similar affinity is shown of gum arabic in solution.

Drawings are made not only on the stone directly, but on prepared paper, and these are transferred to the stone for printing. This has been done from the first—indeed, Senefelder invented the transfer paper before he discovered the grease printing. He recommended the paper for its greater convenience. He was searching for a method of multiplying writing, and found it awkward to reverse his writing, as he must do if he wrote upon the stone. The same holds good of drawing. By the double transfer—from paper to stone and back to paper—the drawing prints as it was drawn, instead of being reversed. The actual drawing leaves the paper, attaching itself to the stone, and the only difference is that the underside of the chalk marks is now inked and printed from, instead of the face. Besides the convenience of making drawings in the same direction as they will print, the transfer paper offers the draughtsman relief from the portorage of heavy stones from office to studio, or to the place where the portrait or landscape is to be drawn. For these reasons almost all lithographers, since the early days of the art, appear to have had recourse to transfer paper. It is generally regarded as an alternative method, and the word lithograph has covered both drawing on the stone and drawing by transfer. Anyone who wished to particularise, has done so by saying “drawn on the stone, by So-and-so.”

Stones are grained to make the print appear as if it were a drawing done on rough paper. Transfer paper is often grained to make the print look as if it had been done from

stone, and some of the old transfer papers had a grain which was too obvious. These papers have now been brought to such great perfection that it is impossible to distinguish work done directly from work that has been transferred. Some artists are of opinion that all the effects that can be produced on stone can be produced on paper, while others deny this. It depends on their fineness whether drawings transferred to a grained stone may be multiplied to the same extent as drawings on a smooth stone.

The drawing on the stone is made (1) with lithographic crayon, consisting of soap, wax, and lampblack; (2) with lithographic ink, consisting of similar material in fluid state.

Over the face of the drawing, when finished, is flowed a solution of gum arabic, acidulated with nitric acid. The acid neutralises the alkali of the soap in the crayon and ink, sets the fat free, and in doing so creates a permanent union of this fat with the stone, by forming limestone, which is insoluble in water. The gum of the solution fills the pores of the blank part of the stone, forming a permanent skin, protective against further influence of oil or fat. On the success of this preparation the possibility of lithographic printing depends.

The acidulated gum solution, which has been permitted to dry on the stone, is sponged off with water, and the superficial layer of black which still covers the drawing is removed by spirits of turpentine. The result is a flat, clean surface. The ink on the roller will be repulsed by any water applied to it, while the latter will protect all the blank spaces. The ink, nevertheless, may be deposited in layer after layer.

Printing is next proceeded with. If done on a hand press, the stone lies flat on the movable bed, the design being on the upper surface, and, of course, reversed. The pressman wipes the whole stone with a moistened sponge, which prevents the work from adhering in any place except where the design is. Then he takes a leather roller in both hands, distributes the ink on the ink table, consisting of a stone, and applies the roller to the litho stone. The rolling is done long enough to give every line of the design its due proportion of ink. The sheet of paper is laid on the surface, register being obtained by the edges or by points, and the tympan is folded

down, when the bed is run in. The tympan may have a leather, zinc, or brass backing, and this back is perfectly smooth. There is no overlay on the tympan, nor, of course, underlay beneath the stone, differences in printing coming from differences in the stone, the ink, the paper, and the drawing. The pressure is caused by the "scraper" of the press, which is a sort of straight edge fixed in the head of the press. Scrapers are made of boxwood, and are from three to four inches wide, and about an inch thick, the lower part being trimmed down to a V section, about three-eighths of an inch wide at the bottom. For metal tympanans these scrapers are covered with leather. The bed moves under and against the scraper with considerable difficulty, as the pressure is great. The carriage is propelled by a kind of winch or a rounce. On its return the pressure is again applied. The sheet when taken off is laid on a heap, as in letterpress work.

Lithographic flat-bed machines are similar in design to letterpress machines. The distance between the cylinder and the bed is very much greater, and is variable, so as to accommodate various thicknesses of stone. The water is applied by rollers, which are at the opposite end of the press from the inking rollers. In fact, the arrangement is not unlike that of an ordinary letterpress machine in which the forme is inked at both ends, but in this case water is substituted for ink. The inking rollers are of leather, with iron cores; the damping rollers have iron stocks, several thicknesses of flannel, and outside some coverings of a linen fabric. The cylinder is covered with a thick elastic blanket or by india rubber. The ink used is stronger and more tenacious than ordinary printers' ink.

Rotary lithographic machines work from zinc or aluminium plates carried on a plate cylinder. This operates against an impression cylinder and is fed with ink much in the same fashion as the usual rotary press.

Chromo-Lithography, or colour printing by the lithographic process, is done in the manner here outlined. A painting of the object is first obtained, and the process of reproducing it begins with analysing its colour from a colour scale, to serve as a guide in future operations. The next step is to cover the painting with a sheet of perfectly transparent gelatine,

upon which the outline of the design, as well as of the different colours, is to be drawn with lithographic ink. This drawing on gelatine, transferred to a stone by simple pressure, and inked up, gives the key plate. The artist has to draw a separate plate for every colour, and has to obtain an absolute register between these separate plates, to make the whole design come out perfectly. Impressions are taken from the key plate in common black ink, on hard, highly-calendered paper, dusted over with finely-powdered red chalk, which only clings to the ink. Thus they are transferred to as many stones as the particular subject requires.

The artist now has a stone to work on, presenting a red chalk outline. The stone, when drawn upon, undergoes the usual preparation, and is proved, the black crayon and ink being first cleaned off with turpentine. Printing is done in the ordinary way of lithography. For securing register, fine cross marks are drawn with pen and ink on the top and bottom of the key stone, and these transfer themselves with the key on every stone to be lithographed. A pin stuck through the centre of each of these cross marks from the back of the sheet, and pointed into the centre of the corresponding marks on the stone, brings the sheet into proper position for exact register. An expert artist will prove from twenty to forty stones in as many different colours, and arrive at precisely the final result intended from the beginning.

Lithographic Offset Printing. Offset printing is popularly supposed to have owed its introduction to a “miss” made in printing on a lithographic cylinder machine. Because the feeder missed a sheet the impression was given on the cylinder blanket, and this in turn imparted a reversed impression to the sheet fed immediately after. This impression was transferred or set off from the cylinder blanket. The successful impression produced on the wrong side of the paper from a soft, yielding surface drew attention to the possibilities of such a method for printing upon any surface. Machines—both flat-bed and rotary—were introduced, and offset printing became an approved branch of lithographic work.

Collotype is a term used to designate the process of printing in a greasy ink from a gelatine surface. This surface is

merely a thin film which adheres to a glass plate, and having been sensitised with bichromate of potassium, is exposed under a photographic negative. The portions of the film acted upon by the light transmitted through the clearer portions of the negative become insoluble in water. A plate thus exposed, washed, and then dried, will, when treated in a similar manner to a lithographic stone, display similar properties. It will in some places refuse moisture and take a greasy ink, whilst in others it takes the water and refuses the ink. Between these two extremes there is a complete gradation, represented in reality by a reticulation or grain, but so fine is this reticulation that the impressions obtained from a properly prepared plate give pictures of high artistic qualities and with true half-tones. Various kinds of presses and machines are used for printing. Generally speaking, the method is the same as that of ordinary lithography, with some differences. The printing being done from glass plates, much less pressure must be put on than when printing from stone. There must be a mask to preserve the edges of the print from being discoloured, and in inking there are also differences. The collotype machine is somewhat like a lithographic machine. Most delicate work requires double or treble rolling. The pressure to the cylinder is given by carriage springs. In this process negatives from nature can be used.

Photo-Lithography. In this process a lithographic transfer is obtained, only from a drawing in line, dot, stipple, or chalk. The copy may be of the same dimensions as the original, or be reduced or enlarged. The copying is done by photographing on glass. The negative is put into a photographic printing frame, and a piece of sensitised transfer paper is placed face downwards upon it, the glass being exposed to the light. When sufficiently exposed the frame is carried into a dark room, and the photographic print is taken out and laid face downwards on a stone coated over with transfer ink, and pulled through the press. It is then soaked for a few minutes in hot water, and the worked side of the paper sponged with gum water, to remove the transferring ink from the parts upon which the light could not act. After being washed with warm water, it is allowed to dry, and is then transferred to the stone and printed from in the usual manner.

Zincography is a process resembling lithography, but zinc plates are used instead of stones. They are more economical in first cost, and more portable. Drawings on zinc, whether in chalk or ink, are executed on a grained surface; and the method of transfer by paper, as in ordinary lithography, is applicable.

Algraphy is a similar process, but done from aluminium plates.

Oleography differs from chromo-lithography only in name. It is an attempt to imitate oil painting. The finished print is mounted on canvas, sized, and varnished. The loaded colours of the painting and rough textures, if there are such in the original, are suggested by embossing.

Letterpress Transfers are made from surfaces in relief, such as type formes, wood engravings, stereo blocks, and the like, as well as from copperplates. In the one case the method is often employed to obviate the necessity of stereotyping. It is a quicker process; a number of transfers may be laid down on the stone, and from such litho prints there is, of course, no impression on the back. Transfers from copperplate are made in order that they may be printed by lithography, which is much cheaper and more expeditious than plate printing.

Letterpress transfers are made on a special paper, which is preferably bought ready prepared from the supply houses. If this is not convenient, well-sized paper may be coated with a mixture containing one part isinglass, one part flake white, and enough gamboge to colour it. These materials are dissolved over a slow fire, and the mixture is strained through muslin. The paper is once coated over very evenly, while the composition is in a warm state, with a flat camel-hair brush. The ink for ordinary letterpress printing, as it contains a portion of soap, may be used in pulling the transfer, which is best done on a hand press. A firm, sharp impression is necessary; a card may be put at the back of the paper, or hard packing may be adopted.

Transfer paper must not be handled or touched, except at the edges, for finger marks from a moist or greasy hand will print as blotches.

CHAPTER XXXIV.

TYPE FOUNDING.

THE art of type founding as usually practised consists mainly of six processes, as follows :—

1. Designing the face.
2. Cutting the punch.
3. Striking and justifying the matrix.
4. Alloying the type metal.
5. Casting the type.
6. Dressing and finishing the type.

John Southward's "Modern Printing."

Designing the Face. Type faces are designed usually by artists well acquainted with the special requirements of the trade, or by the engraver of the punches. The basis of existing founts is, in all cases, derived from either the early black letter, or the later development of the Latin school.

The old style now so much in use is a modification of the face in general use in the seventeenth and eighteenth centuries, of which the Old Face engraved by William Caslon in 1765 was the first perfected example and still remains the highest standard; later on, modifications of this style were brought out by all the British founders, one of these being the face in which the present work is printed.

Every printer can tell at a glance the difference between an old style roman, a modern roman, and a De Vinne. The modern face was designed and adopted during the last century, and its best examples were supposed to be those of Bodoni, of Parma. The De Vinne style may be described as a modification of old style in the direction advocated by the great American printer—the doing away with sharp hair lines, and the strengthening of the body strokes, with a view to greater legibility. It is not, however, intended for

book-work, being a display letter. The Cheltenham marks not merely a new series but the further development of old style, more particularly in its feature of long ascenders and short descenders. Cheltenham in fact created quite a school of its own, developing it in a remarkable range of styles and sizes.

Cutting the Punch. The face of a type is cast from a matrix, and this matrix is usually formed by the use of a punch. The latter may be described as a type in steel. It is a small steel bar about two inches in length, on one end of which a perfectly plain smooth surface is prepared. This has to be delicately engraved to the exact shape and size of the type required; and to assure this, in some cases, such as the inside of a letter, it is customary to utilise what is termed a "counter punch," which is a hardened steel tool. The "counter" of a letter, such as the open space within the circular stroke of the letter o, is formed by the "counter punch." The punch being placed in a vice, the counter punch is placed in position over the punch, and driven in by a hammer. It is easier to drive in the counter punch than to cut out those parts which are to be left hollow. The depression thus formed may require to be enlarged and deepened; the slopes may not be accurate. These defects may need to be remedied by engraving, but this is not often necessary, and, when possible, is avoided. Minute callipers and measures are employed to test the accuracy of the work.

As the letter is in progress a proof is taken—a smoke impression obtained by holding the punch over a gas flame until the face is blackened, and then pressing it on paper.

Punch cutters use gauges wherewith to determine whether the body-strokes of the letter are all of the same thickness, the cross-strokes of the same fineness, the serifs and ears of a proper length, and the letters themselves respectively of the proper height. There are, moreover, certain scales and proportions which the uprights, the crosses, the peaks, the ears, and the serifs, as well as the rounds and the kerns, forming the different parts of the characters, should bear relatively to each other, each great foundry having its own rules and characteristics. In every fount the lower case n is taken as the standard for all the square lower case letters, and the o for round ones; while among British typefounders

the capital H and O are regarded as the standards for the several varieties of upper case letters or capitals. The lower case n (which is about two-thirds the width of the m) is taken as the measure of the width of the square letters like h, k, u, v, and x, as well as of the double letters fl and fi. In rounded letters, on the other hand, as in a, c, e, b, d, p, q, and g, the lower case o is the standard for the round part of such characters—since all these must have the same comparative form of curve.

The steel is first annealed to make it workable, and after the engraving of the punch is finished it is re-tempered, so as to be capable of being driven into the piece of copper or other metal forming the matrix.

To make a punch not only requires an operator who is an expert engraver, and has a complete knowledge of the proportion and relation one printed letter should bear to another, but the steel has to be of the finest quality. The punch-cutter uses magnifying lenses and delicate tools and instruments made to measure even the ten-thousandth part of an inch.

Striking and Justifying the Matrix. The matrix is an oblong rectangular piece of copper, with a highly burnished surface. It is fixed in a block, and by means of a sharp blow the steel punch is driven into it, leaving a deep clear impression. In this condition it is called a “strike.” The burr caused by the displacement of the copper is smoothed away and the depth tested by delicate instruments. After being carefully planed, squared and adjusted, the strike becomes the matrix in which the face of the type is to be formed.

Each letter must have a little space above and below the face—known as the “beard”—as well as at the sides; the latter decide the “side bearings,” or the “set” of the letter. These spaces are determined by the justifier of the punch. The justifying of a fount is most important, for if the letters have not their proper alignment, and are not at the proper distance—however minute—from each other, the effect is very unsatisfactory and the fount is an inferior one.

Electrotype Matrices. Some of the most satisfactory and uniform matrices are produced by the electrotype process, though some type founders are averse to the use of this method,

on the ground that it facilitates piracy of designs. For this process the character can be cut on brass, which is much easier to manipulate than steel, or upon type metal. A type from another foundry can be employed for the same purpose, in which case the master type is electrotyped, in order to form the matrix. The character is suspended in the bath of an electrotyping battery; the character is "grown" to the necessary thickness and then backed with a piece of copper of the size and strength desired.

Alloying the Type Metal. The usual ingredients of type metal are lead, tin, antimony and copper, no two founders using the same alloy. Lead gives ductility and malleability to the composition; antimony gives the hardness; tin gives toughness and sharpness of face; and copper increases the toughness. The formulæ for mixing the different metals vary according to the character and the size of the type.

Casting the Type. The matrix, as already mentioned, forms the face of the type; the body is formed by the mould. This mould is of hardened steel, constructed so as to open in two halves, so that the type may be released when cast. There are at least two kinds of moulds—the hand mould and the machine mould, the principle of both being alike. The former is held by the workman in one hand, while he pours in the hot metal from a spoon or dipper into the orifice of the mould. At the same time he gives a jerk to the receptacle to make sure that the fused material enters all the recesses and to expel the air. This process, however, is now practically obsolete, being used only for faces which are out of date, and for which the demand is very small. The machine mould opens and shuts automatically. The matrix is at one end, and the metal is driven in by a force pump, thus ensuring a solid and well cast type. The type falls out with regularity and speed, the machine accomplishing many times as much work as a hand caster in a given space of time, while the quality of the type is superior to hand-cast type. With the old hand mould a man could cast from 2,000 to 3,000 types a day; with the machine mould he is able to average about 40,000 a day.

Dressing and Finishing the Type. This process is now, owing to improved machinery, less necessary than formerly,

except in the case of such types as are kerned, or must join flush. The perfecting of the types after they left the hands of the caster involved four distinct operations—breaking off the jets ; rubbing the broad sides of the shank ; dressing the fronts and backs ; and kerning such letters as have an overhanging portion at the top or bottom. Attached to the shank of the type when it left the mould was a superfluous stalk of metal called the jet. This was broken off by boys at the rate of over 2,000 per hour, a feat which will appear the more wonderful when it is stated that the types had to be seized by their narrow edges instead of their flat sides, to avoid injuring them. The jet is now either broken off by hand or by the mould itself in the act of delivery. Rubbing consisted in smartly passing the broad side of the type over a flat surface which lay flat on a bench before the rubber, and the shank had to be turned over with the thumb, so that the reverse side of it might be presented to the stone during the backward movement of the fingers. This was done at the rate of about 30 a minute. The dresser was a skilled workman who, after the types were arranged for him in a sort of composing stick holding one long line, had to transfer them to his bench, and to take off first what is called the break of the jet from the bottom of the shanks, by running a groove along the foot of the line of letters, and then smoothing down the grooves by means of a piece of sheep's skin. After this he proceeded to scrape, with a sharp knife, the backs and fronts of all the types in the line. Dressing has still to be done to some extent in nearly every foundry. Afterwards the faces of the letters are examined with a watch-maker's lens, and the letters which are found to be in the least defective or damaged are removed by means of a bodkin from the others. Kerning—also done by skilled workmen—is necessary, of course only where the design requires it in roman faces. In italic characters, however, there are many letters, both capitals and lower case, in which either the upper or lower parts overhang the shanks of the types in such a manner as would prevent their sides, when set up for printing, coming into contact with the letters next to them. Such are the letters *d* and *l*, *j*, *g* and *y*, and most of the capitals, which require metal being cleared from

underneath their overhanging parts. The types are afterwards made up into parcels called pages.

Mechanical Matrix Cutting. Matrices are also engraved by a mechanical method, necessitating the use of a delicately adjusted, highly intricate and costly machine. As a rule the standard type foundry pin their faith to hand engraving, but the mechanical matrix cutter is largely drawn upon for certain classes of work by some houses. There are at least three distinct appliances of this class, but these operate on similar lines, the difference lying in the direction of adaptability to a variety of sizes and details of finish.

In the machine process the first step in the production of a matrix consists in the preparation of the pattern. The style of the face having been decided upon, the letter is drawn on paper on a scale some hundreds of times larger than the size it is actually to be. The object of thus enlarging the letters is to ensure that all the curves and the lines will be uniform; that all the thick strokes are of the right strength; that the hair lines correspond—in fact, in order that all the niceties of type designing may be observed, and the whole of the letters of an alphabet agree with each other in every detail of face and position on the body. This enlarged copy is next reduced by a pantograph method to suitable working dimensions. The reduction is made on a piece of brass, which is hollowed out like a stencil. This brass plate—something like a stencil plate, only the metal is not pierced through—forms a guide for the cutting. The operator follows the outline of the letter on the brass plate with the point of a lever. This action communicates a reduced, although proportionately exact copy of the movement to the blank punch. The revolving cutter of the machine cuts out the metal against which it is pressed, leaving the intaglio letter on the blank behind. In this way, by the same machine and from the same pattern, matrices can be cut of various sizes, merely by adjusting the arm or follower.

The engraving of such a matrix takes but a few minutes. While the old method of striking and justifying requires highly paid artisans of the utmost skill and experience, the matrix thus cut with mathematical exactitude also requires expert handling. At the same time, once the machine is

adjusted, the work proceeds automatically. The machine itself needs, however, to be adjusted with the most delicate precision. A great number of minute measurements require to be taken by micrometer gauges, and microscopes utilised.

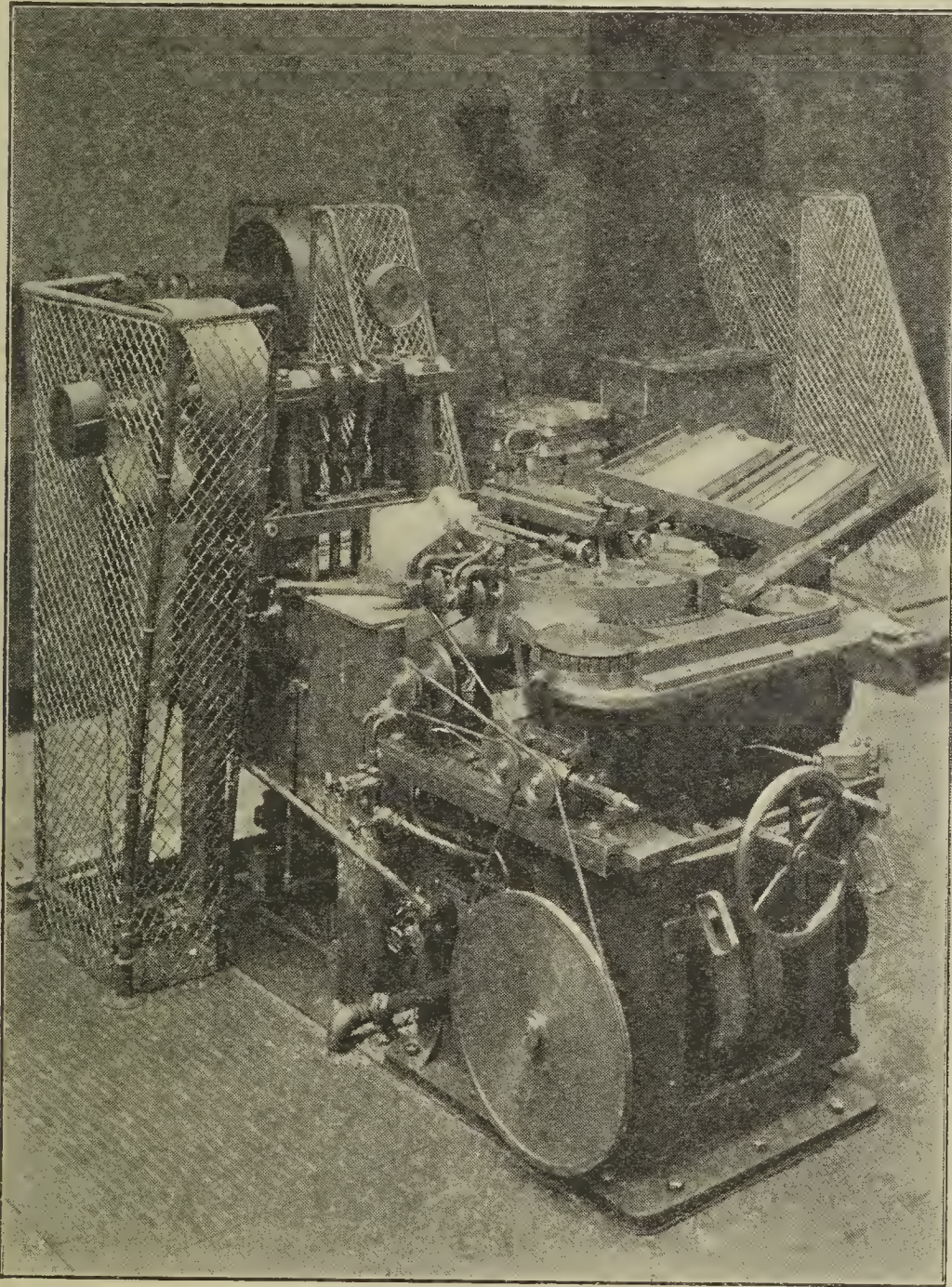


FIG. 48. THE WICKS ROTARY TYPE CASTING MACHINE.

In the foregoing description reference has been made to the processes of casting. Mention may be made also of a casting machine designed upon entirely new lines.

The Wicks Rotary Type Casting Machine forms a marked

departure from the usual method of mechanical type casting. This is an apparatus for casting types with extreme rapidity, invented by the late Mr. Frederick Wicks.

In the Wicks machine is a horizontal wheel, on the surface of which are cut radiating channels, extending from the centre to the periphery. In each of these channels slides a piston, having a matrix struck on its extremity nearest to the periphery of the wheel. This channelled disc has a cover, so that when viewed from the outside the rim presents a succession of small openings, each the size of a transverse section of the type to be cast in that particular channel.

As the wheel revolves, these openings pass in succession before a minute opening in the covering of the end of the mould, through which a constant stream of molten type metal is being forced by quadruple pumps. At the moment at which any orifice passes before the nozzle, the movement of the piston in that particular channel has brought the matrix to its point of greatest retraction from the periphery of the wheel, thereby leaving a horizontal depth of mould exactly equal to the height of the type to be cast. The mould receives its charge of molten metal and passes along, the next in order immediately receiving a similar charge, and so on in endless succession. No sooner has a mould passed the nozzle than the matrix-piston immediately begins to extrude the newly-cast type. Gradually sliding towards the periphery, it forces out the type, which is finally received in the grooves of a travelling chain. From this chain the types are automatically deposited side by side in a long steel channel, which in width measures the height of a type. At the end of every four revolutions, the 400 types produced are removed and set on end. In each row the order of the letters is exactly the same, so that, as row is added to row, lines of similar letters are built up, these lines of identical letters running, of course, at right angles to the original rows. The type is therefore already arranged for delivery to cases or composing machine. The speed of the machine is extraordinary. One thousand types of all sorts are delivered each minute, giving 60,000 per hour as compared with 3,000 by the machines in common use.

Type founding is also provided for in some of the composing

machines, which combine arrangements for casting the types and setting them up. The Monotype Machine, for instance, does this.

In ordinary foundries *spaces* are cast with a blank instead of a matrix; *quadrats* also with a blank, the mould for each being lower, so that they may stand lower than types. *Quotations*, if hollow, are cast in moulds in which the matrix is replaced by a core or pyramid of brass, which projects into the body of the mould, so that the metal flows round all the sides of it, and forms a hollow mechanical square.

Leads are produced in a special mould, in two halves, the space or channel between being regulated by screws, which are termed bearers. These, by being moved up or down, serve to give the requisite set or thickness to the leads. Improved methods of making leads, however, are now adopted, as referred to in Vol. I, p. 94. The specially designed machines now used not only supersede the mould method, but produce to any length, the subsequent cutting, trimming and shaving being also done mechanically. *Clumps* are produced in the same manner as leads were formerly. *Metal furniture* is cast in moulds fashioned like those for clumps, with the exception that the furniture moulds are fitted with cores, so as to produce an open rather than a solid mass of metal.

CHAPTER XXXV.

PHOTO PROCESS BLOCKS.

SINCE the last edition of this work was published, common use and therefore greater experience on the part of the every-day printer has allowed of process blocks being printed with greater ease and certainty in results. Improvements in machinery, paper, and in the process blocks themselves have also contributed to this desirable end. A detailed description of the process through which each kind of block goes is not so necessary and may be obtained from the technical books on block making. We therefore devote attention to a description of the different classes of blocks, their limitations and uses. Although a few of the larger specialist printing firms have their own photo-engraving plants, it will be found generally that this is for some special purpose. In the vast majority of cases not only will work be done quicker and better by the trade house, but also cheaper, though on this latter point remember that it is well to pay a fair price, as on no portion of the printers' material is cheeseparing so mistaken a policy as in buying process engraving. On this one can save so little and risk to lose so much. If the blocks are good, one is nowadays pretty sure of a satisfactory result, and the printer will be repaid by all the care taken on the forme, but if the blocks are poor then no matter what the pressman does, or how much time is spent on the work, he cannot print them well.

The process of photo-engraving requires first a negative consisting of the design or picture in clear glass surrounded by opaque density ; this negative is "printed" on to polished sheet metal coated with a solution which, if light be allowed to act upon it, will become insoluble in water, therefore, when acted upon through the negative, where there is clear glass (design), becomes insoluble, whilst the other part of the sensitive coating is not acted upon and can be washed

away ; the result being a piece of metal on the face of which is the design in insoluble material. This insoluble material is further treated to render it sufficiently strong to resist acid and the metal is then placed in acid which etches the bare parts of the metal, leaving the design or picture in relief.

All methods of photo engraving are in essentials done in this way and differ merely in detail.

There are only two main kinds of process blocks—line blocks and half-tone blocks—and these are made similarly. The most important difference is that in the line process the original is photographed in the ordinary way, whereas in the half-tone process the original is photographed through a cross-line screen which is interposed between the sensitive plate and the lens.

“ LINE ” ENGRAVINGS.

Line process blocks can be made from any “copy” which will allow of a negative being taken in only two degrees of density, viz., clear glass and dense black, without using a screen. The most suitable copy is, of course, a pen and ink or line drawing on white bristol board. The line drawing should be in black indian ink or the popular fixed inks, but the blocks can also be made from type impressions, wood-cut impression, certain textures, etc.

The process is most useful commercially for advertisement designs in the Press which need to be as distinct as possible under conditions of printing of a very severe kind. It is also useful for label work, letter headings, diagrams, and also all printing on paper with an unglazed surface and for printing at great speed. In this connection may be mentioned the line colour process which is used for rough papers, rapid printing, and the simpler forms of colouring, for which it is less expensive than three-colour half-tone. During printing, slight variations in register may occur without seriously affecting the quality of the work.

THE HALF-TONE PROCESS.

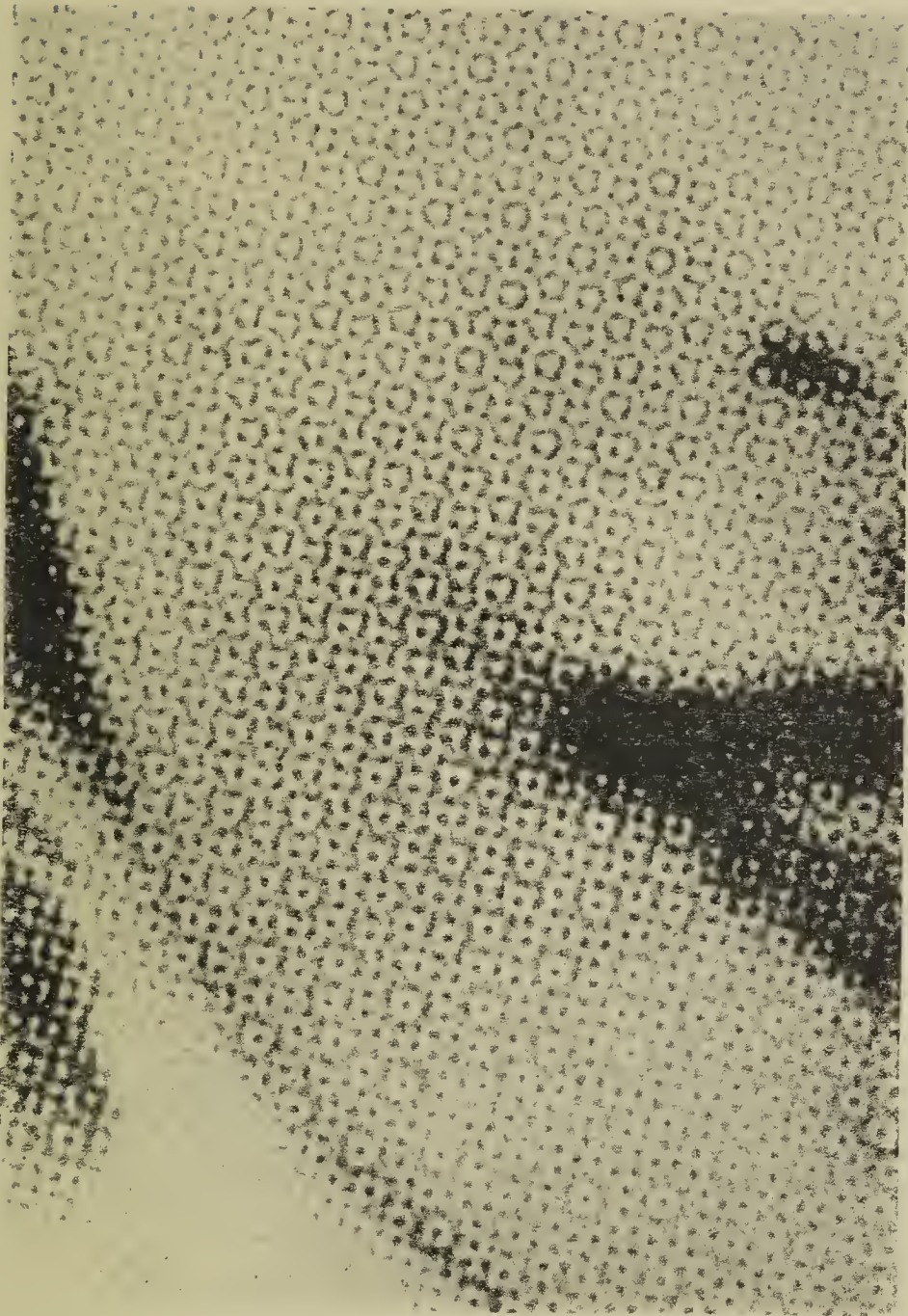
By means of the half-tone process a letterpress printing block can be made from almost anything. It is therefore a process of extreme usefulness for all illustrative as well as commercial purposes. As said previously, the method differs

from the line process mainly by reason of the use of a cross-line screen which is interposed between the lens and the sensitive photographic plate. The action of this screen is to break up the picture (the photograph, drawing or whatever it is that is being engraved) into thousands of dots of light (480,000 in a block 4×3 inches, 200 line). These dots of light are of varying size, small in the shadows, medium in the half-tones and largest in the high lights, and the photographic plate is acted upon accordingly with the result that a negative is produced in which the picture is shown in terms of clear glass and dense black, there is no variation in density. The "between" tones of the picture are rendered, however, by the varying sizes of the clear glass spaces and not as in an ordinary photograph by varying density (or thickness of silver deposit). The clear glass spaces, of course, are the familiar "dots" in the resulting half-tone block.

There are 1,400,000 dots in a block 7×5 inches made with a 200-line screen, and if one of those dots should be missing from its place its absence is apparent to the naked eye. This is a troublesome army to marshal, for if the dots are too big in the lighter portions the picture is dull and lifeless; they may be as fine as needle points, yet a fraction of a minute too long in the acid and the needle points are bitten off, and the printer will be troubled with "black up" (that is unless the engraver is a conscientious man, throws the plate into the hell box and makes it again).

THREE-COLOUR PROCESS.

The same principles apply to this as to the half-tone process and the methods are the same, except that for each picture three negatives are made on specially colour-sensitized plates, each of which is taken not only through a screen at a different angle to each of the other two, but also through its own separate colour filter. For the yellow printing block a blue filter, for the red printing block a green filter, and for the blue printing block a red filter is used. Great care has to be taken that "register" is kept, for lack of register in the superposition of the three primary colours to the extent of only $\frac{1}{300}$ th part of an inch is objectionable to the eye and is destructive of both detail and accurate colour rendering.



A piece of three-colour print, enlarged fourteen diameters, which shows how the yellow, red and blue dots lie together on the paper. The upper portion is the most characteristic, the dark dots being blue; the red and yellow have reproduced about the same tone and connect up to the blue, making the five-sided shape. The light patch in the bottom left corner consists of red dots only, the blue and yellow not being required here.

HINTS.

Photographs, drawings, etc., may be engraved same size, reduced or enlarged, but generally enlargement is inadvisable as some lack of sharpness occurs and the reproduction is coarsened.

* * *

Reduction or enlargement can only be done proportionately; what this may be can be reckoned by ordinary "rule of three."

Thus if your drawing or photograph is 6×4 inches and you want it to be engraved 3 inches the longest way, then $6 : 4 :: 3 : x$.

$$\frac{4 \times 3}{6} = 2$$

* * *

The following is a convenient way to find the proportions an original will reduce to :

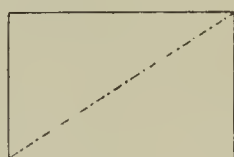


Fig. 1

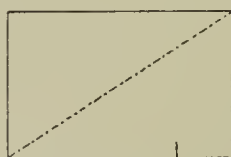
The
width required

Fig. 2

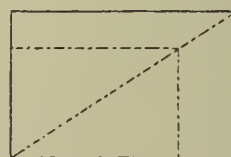


Fig 3

Turn the photograph or drawing face down and with a ruler and pencil draw lightly a diagonal line on the back from corner to corner (Fig. 1), then measure from the left side the width decided upon, mark this (Fig. 2) and rule parallel to the right hand side of photo, from the mark until it bisects the diagonal (Fig. 3). The measure of this line is the correct height that the photograph will reduce to when made the width marked (Fig. 2).

* * *

Give the size required *in inches*. “Half-size,” “To go on crown 8vo,” “Postcard size,” and similar phrases, are sometimes liable to be misunderstood, and in nine cases out of ten the size required in inches can be given and will save all chance of error.

* * *

A line block cannot be made from a photograph or wash drawing without first making a pen and ink drawing (extra cost).

* * *

An electro is a cast from an existing block, and an electro cannot of course be made from a photograph or drawing without first making a half-tone or line block from which to cast it.

* * *

Pencil drawings cannot be made into line blocks without being first inked in (extra cost), but they can be engraved by half-tone process direct without inking in.

CHAPTER XXXVI.

HINTS ON THE CARE AND PURCHASE OF MACHINES.

THE proverb, "A workman is known by his tools"—that is, the condition in which he keeps them—is applicable to the machine minder with regard to his machine. The condition in which it is found is to a great extent an indication of the character and the abilities of the machinist, and of the quality of the work he is likely to produce.

The competent workman will keep his machine clean and in perfect order, while the unskilful man, who perhaps hardly realises its importance, usually neglects it. Justice, however, demands that it should be added that the fault does not always lie with the workman. There are employers who begrudge a few minutes' time for cleaning, and who demand that the machines should be kept running up to the last minute of the working time. Where this is the case, the employer stands in his own light, for he is made to pay a high price for every minute he tries to save from the time required for the due cleaning of the machine and its surroundings.

Many of the stoppages during working hours result from not having everything in order, and much loss through spoiled work, unemployed time, and poor quality of work, are caused by carelessness in the maintenance of machinery. Cleanliness in the machine room is a matter of great moment. Everything should be in its assigned place at the close of the day's work. Soiled rags and the bulk of the dirt which have accumulated should be removed to some place outside the machine rooms. Many serious fires have been caused by the spontaneous combustion of turpentine and rags. Certain men should be detailed to enter the room every morning half an hour earlier than the others, so as to sweep up, and also to cleanse and oil the machinery. A good plan is to arrange for girls or labourers to remain a short time after

machines are stopped for the day, in order to clean up. This allows of machine minders working up to time of closing and commencing running in good time next day. All parts of a machine must be taken care of. It must be cleaned and oiled not merely to attract the eye, but thoroughly, and in all its parts, for the sake of getting the best return from it.

Machines newly put up are generally in good running order, but at the outset the minder should observe carefully that no nuts or screws are loosened. If they are, they must be carefully tightened up.

All unnecessary meddling with the machine must be avoided, but little faults should be repaired or remedied as soon as discovered.

An occasional clean up when things are slack is by no means sufficient for all practical purposes. The consequence is often a most expensive breakdown at a very inconvenient time, when perhaps a job is wanted "in a rush." Timely attention and examination of the condition of the working parts when cleaning would probably have prevented the stoppage.

Care of Machines. The following suggestions for machine minders are supplied by R. Hoe & Co., Ltd. :—

Foundation. It is very important to have a good solid foundation. If there is a bed plate it should be levelled carefully, putting the packings under each side, and letting them be slightly tighter at the ends than in the centre.

If the machine stands on a floor, try it again when all together, for fear that it may have settled out of level, and re-adjust if necessary. Test the level of the machine twice a year.

Cleaning. Clean thoroughly all the joints and fitting parts, and screw them together firmly but without too much force. Clean and oil carefully all the working parts before putting them together. See that all the oil holes are open, and fill them with oil.

Try each moving piece, when put in place, to see that it runs freely, but without play.

Testing. Turn the machine by hand occasionally, while putting it together, and give it a few more turns when it is finished. Then put on the belt and let it run half a day before putting on a forme, observing, in the meanwhile, that

the oil runs freely from the bearings, and the working parts keep perfectly cool.

To Adjust Cylinder. Set the cylinder type-high from the type bed; then adjust the bearers on the bed to those on the cylinder. The packing on the cylinder should be one paper higher than the bearers; this allows for the squeeze, or impression. The cylinder and bed being set, the necessary impression is given by overlays and underlays. The forme should be the same height as the bearers on the bed.

Fountain. Adjust the ink fountain evenly from end to end, then cut off the ink where required.

Changing Formes. To change the cylinder backward or forward with the bed to suit formes, draw the intermediate wheel out of gear with the cylinder wheel. In again starting be very careful that the register rack is properly adjusted, for a little inattention here may cause trouble and expense.

Reversing Motion. Oil must be carefully excluded from the friction grooves in the fly-wheel, and if any oil gets in, it should be cleaned out. No foreign substance should be put in to make the brake operate more promptly.

Oiling. When the machine is new, each bearing should be oiled once every half hour during the first few days, gradually extending the time to twice a day. Open and examine every bearing once a month.

It may be added that the use of bad oil is a fruitful source of mischief. Next to the neglect of regular and sufficient oiling, perhaps nothing contributes so much to breakages, undue or premature wear and tear, and other damage to machinery, as the use of unsuitable oil. Much of the oil used in printing offices has a tendency to clog machines and presses. Several specially-prepared lubricants are sold by dealers in printers' supplies, but for shafting and general machinery neatsfoot oil is perhaps as good as any. Many printers, however, prefer the best sperm, lard, or olive oil, others machine oil.

Caution. Single small cylinder and double-cylinder newspapers machines should not be turned backward over the centre, as the grippers, remaining partly open, may damage the forme and injure the machine.

To adjust gripper motion on impression cylinder of single small

and double-cylinder machines. To prevent the tearing of sheets or dropping of them too soon, care must be taken that the toothed segment on the end of the cylinder rests on its stop pin when the fingers are closed.

Springs. The springs should be regulated according to the weight of the forme and speed of the machine, for a heavy forme or high speed requires more spring than a light forme or slow speed.

Buying Machines. The following useful hints are also offered by the same eminent firm of engineers.

See that the machine offered for sale, whether new or second hand, is strong and well made. Consider the standing of the maker both as a mechanician and machinist. A light-framed or slackly-fitted machine will be dear at any price. Do not be deceived by any beauty of paint or finish on exposed work, which adds nothing to the usefulness of the machine, and which may draw the eye from an examination of the working parts. Uncover the boxes, and see whether the finish of shafts in their bearings, and all journals, is as smooth and true as the work on more exposed pieces. Take out, here and there, screws and bolts ; see if the threads are deep, sharp, and clean fitting. Look closely at the fitting of all toothed pinions and wheels ; note whether they have been cast and filed to fit, or whether they have been accurately cut by automatic machinery, so that they will fit in any position. Slowly turn pinions and wheels, and note whether there is any rattling or lost motion, or whether the teeth fit snugly, yet freely, so as to give even, steady motion. Closely examine all castings for pin holes or air bubbles, which may be most easily detected in work that has been planed. See that castings are heavy as well as solid. Look after oil holes and provision for oiling. See that castings are neatly fitted ; that they do not show the marks of the hammer or file, which must be used to connect them if they have been forced or badly put together. Pay attention to the noise made by the machine when in motion ; if well fitted, the noise will be uniform ; if badly fitted, it will be variable or grating. This can readily be detected.

CHAPTER XXXVII.

THE WAREHOUSE.

ADJACENT to the composing department of every printing office there should be a store—and in the small office this should not be neglected—even if it only consists of a cabinet for blocks, a few pigeon holes for papered-up matter, sorts, etc., and a special rack for standing formes. In large offices this expands to store room proper, separate rooms for stereo and electro plates, blocks, etc., and vaults for standing formes.

The store room should be planned according to the nature and extent of the work of the office, with everything easy of access—"a place for everything and everything in its place" when not actually in use. To illustrate the necessity of this, printers know to their cost and irritation how often special sorts, which are only required at intervals, cannot be found when urgently wanted for a job, necessitating either a long time-wasting search or the equal expense of fresh purchases.

Compositors should on no account be allowed free access to the store, and efficient means must be taken to enforce this, even if the store is part of the composing room. It may be easily separated by having imposing surfaces right across the space with low doors for access, and these should be covered over by a flap, which can also be made useful. If such a method be adopted, and this is an excellent one for a small store, extra imposing surface is obtained, the front facing the room may be fitted to take leads, wood furniture, etc., whilst the store side can also be fitted with fairly large holes or bins, for holding papered-up matter, etc. No single inch of space need be wasted, but should be utilised for a good purpose in all store rooms.

For large founts of body type, an arrangement of large holes or bins, along a wall, to take papered-up matter is

the best arrangement, and can be further subdivided for solid, open, cap or figure dis. In large houses the founts that are in constant use throughout the department should have a small bin for each character, where a supply of loose letter is always kept; if the demand is not so great the old large fount cases will meet the demand.

Bins or large holes should be kept for leads, one for each size and thickness.

Racks should be provided for extra cases and those not required in the composing room for current work. Cases should not be allowed to be piled up on the floor.

Provision must also be made for empty chases; this is nearly always a source of trouble to storekeepers.

A number of imposing surfaces must be provided for laying up formes that have to be cleared away, with a bulk or two; on these the store hands can do their work. If standing formes are stored in the warehouse forme racks can be fitted under them, or the space otherwise utilised.

Stereo and electro plates are best stored in strong pigeon holes. Cuts can also be stored in the same way; but if cuts are few one or two special cabinets will answer the purpose.

The storekeeper must have the sense of order largely developed, and also be able to anticipate the likely requirements of the compositors by keeping up the supply of materials, he will thus be of great help to the overseer in the quick and cheap production of work. He must know exactly what is in the department and where located at any moment, thus being able to say what is available in case he is asked for jobs about to be put in hand. Upon him should lie the duty of examining the cases to see that the display founts are not short and the body type cases are not foul; that all leads, rule, ornaments, borders, etc., are put away in their proper places.

All stereo and electro plates of books should, when off the machine, be handed back to the store and there examined, after which they should be properly packed. This is best done by taking a long strip of paper of three or four thicknesses and the depth of the plate, lay the first plate face

upwards on the end of the paper then fold it over the face of the plate, lay the next plate face downwards on the fold-over part of the paper with the third plate back to back on the second plate, fold the paper over the face of the third plate and so on until the sheet is all placed, when it will be noticed that at the top and bottom are backs of plates; the sheet is then wrapped in brown paper, properly marked and it is ready to be stored away again in its proper place.

Stereos or electros of jobs should be carefully examined, parcelled up and stored away and never be allowed, as is often the case, to "knock about" either the store or composing room.

Half-tone, line or electro blocks should be carefully cleaned, dried, coated with the proper preparation, packed up, stored and indexed.

The storekeeper should keep careful record of everything in the composing department, and when composing machines are used, keep the reserve matrices and have every one accounted for, thus any wastage of matrices can be checked. Thus the storekeeper's books should contain a complete inventory of the composing department, and this is most useful for fire insurance purposes.

GENERAL STORE.

In most printing offices it has been difficult to deal with the hundred and one oddments required daily in the working of the office, and in allocating the proper proportions to the different departments. This trouble is best overcome by establishing a general store to deal with all outside purchases with the exception of paper and type. In very large offices it will be necessary to form a separate department, but in medium and smaller offices it can be added to and placed under the supervision of the warehouse.

The fitting up of the space allotted to this store will of course vary with each office, some needing much more room than others, but as a rule a fair number of large pigeon holes, with shelves and a large cupboard or two, will answer most requirements.

The best method of running this department is to have

it under the control of a person whose main duty is to see that no material runs short, and at the same time to keep a close eye upon unnecessary supplies, either in purchase or in use by the different departments of the office.

If the card system is in use in the office a set of cards as illustrated below, printed with a debit and credit side and ruled can be used as the ledger account, a separate card being used for every different article.

Class of Stock..... Purchased from..... Price.....

Address..... Discount.....

Date.	Quantity received.	£	s.	d.	Date.	Quantity given out.	Dept. or Order No.	£	s.	d.

The particulars at the top of the card are filled in from the official order, and when the goods are received the left-hand or debit side filled in. When any goods are supplied to any department, on receipt of an order from the head of that department, the date, quantity given out, etc., are filled in the credit side. At the end of each week the storekeeper makes out a debit card against each department, which is the stores credit. These cards must be initialled by the head of each department and forwarded to the costing clerk.

If any outside purchases are for special order number, then an outside purchase card should be made out and forwarded to the costing clerk, thus a proper check is kept upon all outside purchases.

By these means even the smallest items are carefully and justly allocated to the proper departments, and the stock in hand of any item at once seen by balancing the store debit and credit card.

If a card system is not in use, the storekeeper should keep

a special book, using one side of an opening for the store debit side, i.e., receipt of outside purchases ; the opposite side being used as the store credit side, i.e., materials supplied to departments. A weekly statement must be sent to each department head and initialled, as in the case with the card system.

By these means a constant check can be kept on these numerous items.

THE WAREHOUSE.

- The warehouse naturally divides itself in three sections :
- The white paper warehouse ;
 - The warehouse proper ;
 - The printed paper warehouse.

In small offices these are run as one department under the warehouse overseer, but in large offices the first is a separate department with its own head.

In the white paper warehouse is kept and stored all kinds of paper, cards, etc., not printed, hence its name.

When a delivery of paper is made, the paper must be carried in, examined and stacked away. The person in charge should at once enter in the white paper ledger full particulars. This book should take the form as illustrated below.

White Printing, Quad Crown, 80-lb. (J. D. & Co.)

Date.		Rms.	Qrs.	Sheets.	Date.	Used for	Rms.	Qrs.	Sheets.
April 10 ..		100	0	0	April 13...	Order No. 50....	20	0	0
" 15 ..		50	0	0	" 15...	Sigs. B and C,			
						Order No. 20..	30	0	0
					" 17...	Order No. 45....	50	12	0
					" 18...	Sig. D,			
						Order No. 20..	15	0	0

Here it will be seen that the deliveries are entered on the left-hand side, and on the right hand how it is used up ; thus, by balancing, the stock on hand is at once seen.

If the card system is used, the following pattern may be used and partly explains itself.

The method of damping by hand is as follows :—On a letter board close by, some common paper is placed, and then a quantity of the dry sheets are laid on the board. Then the same number of sheets are passed through the trough and laid on the dry sheets, and so on, dry and wet sheets being piled up alternately.

The successive portions must be entirely submerged, and then drawn out quickly or slowly, according to the quality and thickness of the paper. The amount of water required must also be regulated according to the thickness of the paper.

After a convenient quantity of paper has thus been damped and piled up, a wetting board is placed on the top. Wetting boards are either battened or flat, the latter being more durable and convenient. A heavy iron weight is then placed on the top. The quantity of the paper will determine the time during which the paper ought to stand under the pressing board, and before it is sent to the pressroom. If it becomes too dry, the pile may be undone, and sprinkled with water at intervals. These expedients, however, are required only when improper judgment or care has been used in wetting.

Drying Printed Matter. All good work, after leaving the machine, requires to be dried. The reason of this is that the ink which is applied to the paper as a tenacious liquid has to become hard on the surface of the paper, otherwise it will smear. This change is not effected at once.

There are several methods of drying printed matter. In all offices formerly, and in lithographic houses to-day, the sheets were hung on lines or poles fixed near the ceiling of the warehouse. They were deposited in portions of half or quarter of a quire on these lines by means of a long pole with a crosspiece at its termination, which was called a peel. The time required varied from a day to a week or longer.

Drying racks are now in general use. They consist of a series of open trays in a frame, and require much less space than the old method. They have two important advantages over poles. The sheets are laid flat, and have no bend or curl in them. The sheets are also protected to a great extent from the dust which floats through the atmosphere.

Paper for photogravure work requires to be damped as

was the case in the old letterpress methods. This is on account of the paper having to be forced into the depressions of the plate and lift the ink from them, a totally distinct method from letterpress printing.

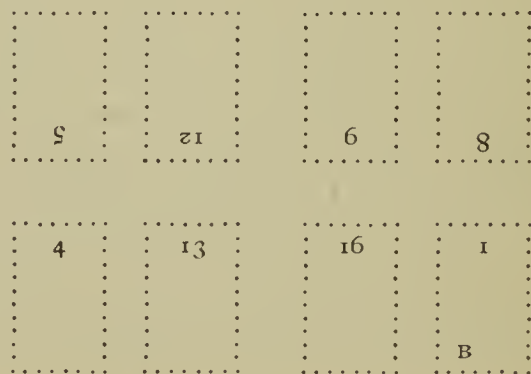
THE WAREHOUSE PROPER.

In this department is done the numerous operations necessary for the finishing of jobs after they have left the machine room; they include examining, counting, folding, gathering or insetting, stitching (wire or thread), sewing, wrappering, cutting, banding or rolling, stamping, and despatching or parcelling and delivery. Nearly all these operations, and a large number of others, such as numbering, perforating, scoring, punching of all kinds, creasing, bending, round cornering, etc., require machinery, therefore the careful planning of the room is very necessary. Remember, also, to allow plenty of board room. The reader who requires a full treatment of this section is referred to a series of articles on "The Warehouse and its Concerns," which appeared in Nos. 139-146 of *The British Printer*.

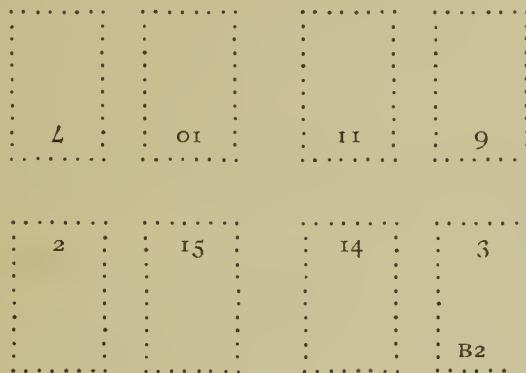
Counting. All work should be counted from machine and examined before the forme is allowed to be lifted; this simple precaution will often save the forme being laid on and made ready again owing to sheets being short or other faults, such as set-off, dirty sheets, wrong colour, etc., causing the number to be short of the required quantity.

THE OPERATION OF FOLDING.

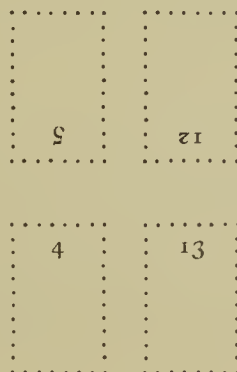
To describe the actual operation of folding take a sheet of 8vo. This consists of eight leaves or sixteen pages, the side containing page 1 being called the outer, and has at its foot the signature as B. This side consists of the following pages:—



and is technically called the “outer” side or forme. The opposite side, or “inner,” will give the following pages:—

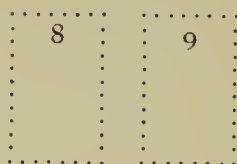


The sheet is placed on the folding board outer downwards, with page 1 at bottom left-hand corner, consequently the inner is uppermost with page 3 at the folder's bottom right-hand side. The folder, with a folding stick in her right hand, places it at bottom of the sheet about the centre. With the left hand the folder takes hold of the top right-hand corner of the sheet and bends it over until the folios of pages 3 and 6 are in register or fall dead-on the folios of pages 2 and 7. When this is attained the back of the sheet is folded down by passing the folding stick, held in a slanting position to avoid tearing or damaging the paper, up the sheet (starting from below the centre) and then down the full extremity of the fold, the downward stroke being given with more pressure. It will now be observed that pages uppermost are



Pages 12 and 5 are now folded over to register on pages 13 and 4, the sheet not being turned round, but the left hand brings the sheet over from top to bottom instead of right to

left as in the first fold. The pages at view after the second fold will be



Page 9 is registered on top of page 8, and the third fold made as before described.

In the highest class of work, to avoid the puckering or creasing that results from folding two or more thicknesses of paper when joined at the top, after each fold, with her folding stick, the folder slits or cuts the sheet along the previous fold until a point is reached about one inch past the centre. If the folding has been carefully done, and register at the printing machine perfect, the pages in the folded section should fall dead on each other and the head margins be the same on each page ; the fore-edge, backs and tail margins should also be uniform throughout the section.

In arranging for folding a job that has to be worked twenty-four pages on a sheet, or 12mo, it is best and safest for hand folding to have it imposed as a sheet of 8vo, with the centre eight folded separately and inserted. This will give better work, save spoilage, time and temper. For machine folding it is no more trouble than a 32-page sheet if care is taken with the creasing at the fourth fold, which is often very bad in this kind of folding, on account of the trouble the air has in escaping. Having the machines arranged for a double parallel fold obviates this trouble, and is better than the slitting apparatus attached to the machine.

The great aim of the folder is to fold the sheet so that in the bound book the pages register exactly, and that they sit on the page perfectly square and with the margins as originally planned when imposing. The careless use of the folding stick causes a great deal of waste and damaged sheets, in breaking or creasing the paper if it be very thick or cutting and tearing holes if it be thin.

FOLDING ON PERIODICALS.

Hand folding of short numbers on weeklies is done quicker and cheaper than at machine ; by putting a number of opera-

tives on each sheet, perfect copies are ready for gathering or inserting, etc., within a few minutes of the giving out of the sheets for folding.

Practically all offices use hand folding as supplementary to the machines. Very few offices have machines enough to cope with all their weekly work in the time required. For folding small sections, such as four pages or insets, hand folding is cheaper than machine; also if there are eight-page sections the machines are better and more economically used folding 16's and 32's, giving the eight-pages to the women folders.

In the folding of thick paper wrappers hand labour is used. In connection with very thick wrappers or covers care should be exercised to see that the grain of the paper runs the right way—that is, with the fold and not across it. Work is often finally spoilt by the neglect of this precaution.

All periodical work is generally “rush” work, therefore it is a case of “all hands to the pump,” and rush work is turned out quicker, especially if there are a number of sheets, by hand than by machines, as short numbers may be finished before the machines can be set to the work; besides, if the job consists, say, of 1,000 of eight sheets, for instance, and only four machines available, the machines would have to be set for four sheets and the sheets folded, then set for the remainder, causing great delay in obtaining perfect folded sheets; whereas sixteen women folders would produce perfect copies in five minutes.

It is most important when hand folding is worked in conjunction with the machines that pace is kept with the machines. Especially is this the case with oddments and supplements.

The folding on weeklies is not looked upon as so important as that required for books and high-class magazines. This has arisen through the rush and the constant working against time. Great care must be taken to get a proper set to fold to, especially with sheets containing advertisements, as these are generally made all manner of depths and widths. Speed is the great essential required of the hand folder on this class of work, and space is always very limited in all departments of a printing office.

This class of work is generally “wet” when it reaches the

warehouse, being "straight off machine." Good hand folders, however, can fold work that cannot be safely passed through the folding machine on account of not being sufficiently dry. At the same time, few printeries of any size depend on hand labour for doing all their folding, although several large binders still do so.

Gathering. When a job makes more than one sheet the sheets need to be gathered. A pile of each sheet is placed on a board, and, as she passes each pile, the woman takes a sheet from the top of each pile, and then returns and commences again. Machines to facilitate this process are obtainable.

Inserting. If the job is stitched through, the sheets have to be inserted one in another; the first or upper is taken off its pile and opened, then the second is inserted in the first; the second is opened and the third inserted, and so on to the finish of a complete copy.

Collating is the process of examining gathered copies to see they are perfect. Another method in sewn and flat-stitched work is to have marks placed in the gutter between the first and last page of each sheet, which facilitates this process.

Wire Stitching. Flat wiring is the process of stitching gathered copies from the first page through to the last page.

Through Stitching. In this process either a saddle or a trough is used—the former when the stitch goes from the outside and clamps in the centre, the latter when the stitch clamps outside.

Sewing. The majority of this class of work is now done with sewing machines; the women's work consisting of one feeding sheets on a saddle and another separating the complete copies. On some machines the first and last sections have to be pasted.

Wrapping. A number of sewn or flat-stitched copies are gummed along their backs. The top copy is then taken and placed in its proper position, and the front of the wrapper drawn over the back and top edge being well rubbed down. The copy is then turned over and the other edge well rubbed down to produce a good square back with sharp edges.

Pressing. The copies are next placed in a standing or other press and submitted to pressure to make them solid.

Cutting. The pressed copies are now taken to the cutting

machine. The fore-edge is first cut, then the tail and, lastly, the heads.

The job is now ready for packing for delivery, or, if a weekly, to be banded for posting.

THE PRINTED PAPER WAREHOUSE.

In most warehouses that are subdivided the warehouse work of book-work is done here. This consists of counting and examining, gathering, collating, booking up, pressing, parcelling and stacking away. Counting and examining have been mentioned. If, however, sheets are dirty with finger marks, etc., they must be cleaned by bread crust, or sand and glass paper.

The gathering of book-work is done in sheets. A gathering of about 24 or 26 sheets is laid down on the boards—a ring arrangement of the boards is best—a boy then starts and lifts up the top sheet from the first heap and carries it to the second heap; the second is then picked up with the first and the two carried to the third, and so on. One boy can follow another; also a number of boys can be on one gathering.

Collating. The sheets when gathered are knocked up and a warehouseman, with a needle in a wooden handle, collates, i.e., sees all gatherings are perfect—the first signatures are at the bottom right-hand corner—the warehouseman then with his needle picks up the corner of sheet after sheet very rapidly, at the same time seeing that the signatures are in rotation.

Each gathering is then folded in half and then pressed. They are then booked up in certain numbers to a parcel, and then parcelled up ready either for delivery to the binder or to be stored.

The greater part of this portion of the warehouse is generally devoted to storing printed matter, and unfortunately this is being increasingly required by publishers.

THE DRYING OF PRINTED MATTER

was formerly attached to this part of the warehouse, but the great improvements in the drying properties of inks almost entirely removes the need of special drying apparatus, except, of course, for particularly urgent work. Photogravure prints

are best dried by laying out lightly on large boards in a hot room. The boards can be placed in racks.

It will sometimes happen that it is necessary to send out work as soon as it is done, although printed with ink which will not dry soon, or upon hard glazed paper which will not absorb the colour. In this case some printers cover it over with powdered chalk or calcined magnesia. Either of these will somewhat dull the lustre of the ink, but the magnesia is preferable. The powders are applied with a pad or linen rag.

FOLDING MACHINES.

It is impossible within the limits of the space available in this section to describe folding machines. When it is mentioned that one firm alone makes these machines in at least seventy different styles, it will be seen not only how printers are enabled to purchase machines to suit practically every class of folding, but the impossibility of describing the various designs in anything like complete fashion.

Folding machines can be classed as job, magazine and book, newspaper and section folding machines. They are also made for attaching to flat-bed printing machines; also with paper cover attachment, and arrangements for folding a varying number of pages, such as 4, 8, 12, 16, 20, 24, 28, or 32 pages. Pointing arrangements can be attached either over or under the feed-board, the overhead being generally used for the best class of book-work. Machines are also made as double 16-pp., quadruple 16-pp., double 32-pp., 16 and 32-pp.—the sections are cut in the machine and delivered as separate 16's or 32's; also for 24-pp. folding as a sixteen and an eight, cutting off the 8-pp. and inserting it into the 16-pp. section.

The following are some of the arrangements that can be added to folding machines :—

Perforating arrangements for folding sheets without any crease at the third and fourth folds. This is very useful when folding thick or art papers.

Slitting arrangements for the same purpose.

Thread-stitching apparatus, single or double. These are inserted automatically in the last fold; the ends stick out at the back. In paper wrapper work this saves sewing, as the

loose ends are glued with the back, and thus securely fastened to the back under the cover. This system of paper wrapped work is extensively used on the Continent.

Supplement attachment. This should be a direct feed and require no tapes to carry the supplement to the main sheet.

Trimming apparatus. This should be designed so that the amount of trim is regulated by a single set-screw.

Pasting arrangements.

When purchasing a machine for general work it should be capable of folding and delivering 8, 12, 16, 24 or 32 pages. It should also be fitted with an extra arrangement, such as being capable of folding the second and third folds parallel or the third and fourth parallel; this will be found of great service. The following are the principal points to guide a printer in purchasing :—

Simplicity of design—all parts easily get-at-able.

Substantially built and of good material.

All parts interchangeable.

Quick and noiseless in working.

Should work with the greatest accuracy.

Capable of being adjusted from one size sheet to another in a few minutes.

Should be capable of folding any kind of paper—thick or thin, smooth or rough.

Speed should only be limited by the capacity of the operator.

The tapes should be self-adjusting.

Should have automatic sheet-straighteners or guides.

The knives should have a direct and certain action, and, when required, the first fold knife should be capable of being instantly held up without stopping the machine.

The rollers should be capable of adapting themselves to all weights and grades of paper.

The machine should be compact. There is a great difference in the space occupied by different makes folding the same sized sheet.

Should be capable of folding work straight off machine. To accomplish this, the best arrangement which experience has proved is to have the first and second pairs of rollers made of rubber; the third and fourth can be steel rollers.

Power required to run machine should be small.

All gear should be inside the frame, thus preventing injury.

The rollers of the third and fourth fold should be of extra length, to enable the machine to fold to the extent of the largest sheet, 16's and 32's two up; delivery boxes must be arranged for this also.

A great point is the variety of folds the machine will do and deliver effectively.

Position of delivery boxes, whether get-at-able; also whether the stacking arrangements in the delivery boxes are good.

In hand-fed machines the operator should on no account have to pass his hand or part of his arm underneath the knife.

Folding machines are made semi-automatic by the addition of drop-bar feeders. This is a great convenience to printers, as the speed is only limited by the capacity of the stroker-in. The sheets in this arrangement are stroked down to marks. They are then taken into the tapes by a drop-bar and carried into the machine, being afterwards brought into their proper position under the first knife by a special automatic adjuster.

Most of the folding machine manufacturers now attach to their machines a feeding apparatus.

CHAPTER XXXVIII.

THE LIGHTING OF THE PRINTING OFFICE.

IT is now recognised that good illumination, like pure air, satisfactory ventilation and sanitary arrangements, is a hygienic necessity.

Moreover, as printing is a business which demands good light and plenty of it, the very best method of lighting must be adopted. It should be remembered that very much of the work in the printing office has necessarily to be done at night time and artificial illumination resorted to regularly. The employer requires a method which is sufficient, economical and safe; the employee a system which is not in any way detrimental to eyesight and adequate for the proper performance of his or her duties. Remember also that defective eyesight—often caused by bad light—has a considerable bearing upon general health.

Printers are beginning to realise that good illumination pays, and that an employee cannot do good work if the illumination is insufficient and the lights or lamps are misplaced; also that bad illumination means spoilt work, reduction of output, frequent accidents, and the creation of dark corners wherein there is sure to be an accumulation of dirt and perhaps of valuable material which will be practically unused.

Space will not allow of detailed treatment of this subject, and only a few hints on the different methods of illumination can be given.

The sources of light for the printer are sunlight, gas and electricity.

Sunlight is, generally speaking, the most healthy, and the least fatiguing. The direct rays of the sun, however, bring about hurtful changes on the retina. The light should fall on the work rather than on the face. There should be no shadow from the hand. (Remarks on the structural

arrangements of printing offices in connection with lighting will be found in Vol. I).

It may be mentioned that printers with offices situated in the narrow streets of large towns could make a far better use of daylight by the careful placing at proper angles, outside the lower windows, of the patent reflectors now on the market.

There are three methods of illumination by artificial light :

- The direct method ;
- The indirect method ;
- The semi-indirect method.

The direct method is obtained by lamps or lights with suitable reflectors, placed at proper intervals. This style is suitable for offices where there are a number of desks or in the warehouse where there are a number of benches, all of which require an equal amount of light and a good general illumination is needed. Paper shades or reflectors are not now allowed to be used. The Fire Insurance conditions prohibit these.

The indirect method of lighting is obtained by placing underneath the sources of light opaque reflectors which throw the rays on to a white ceiling, whence they are diffused all over the room. The light coming from so large an illuminated surface makes this form of lighting specially suited to rooms containing machinery, as the light penetrates into the smallest recesses and corners.

The semi-indirect system is obtained by using a translucent reflector ; a portion of the light is transmitted directly downwards, thus combining the advantages of the direct and indirect systems.

In the case of readers, pickers, etc., in the foundry, and compositors to a certain extent, a strong light is required in a particular restricted area (local illumination). Lamps or lights must be placed close to the work and a shade completely screen the light or lamp from the worker's eyes.

Gas. There are at the present time three principal systems of lighting by gas :

- The open burner ;
- Incandescent burners ;
- High-pressure systems.

The open burner should ere now have been dispensed with, being of a low illuminating power and very expensive compared with other systems.

Incandescent burners. As soon as these came into general use they quickly displaced the open burner, giving a better and cheaper light. They have also displaced electric light in a number of offices.

The high-pressure system of lighting is the latest and most economical form of gas illumination, and is being so rapidly adopted that the large gas companies lay down high-pressure mains, thus saving printers the trouble of installing a pressure plant.

To give a comparison of the cost of the above three systems, take as a basis 1,000 candle power for one hour, with gas costing 2s. 6d. per 1,000 cubic feet.

The ordinary fish-tail burner at 3 candle power per cubic foot per hour=333 cubic feet. Therefore 1,000 c.p. per hour	= 10d.
Incandescent burner at 60 candle power per 4 cubic feet=66 cubic feet. Therefore 1,000 c.p. per hour	= 2d.
High pressure=35 cubic feet. Therefore 1,000 c.p. per hour	= 1d.

A great objection raised against the use of gas is that it vitiates the air and unduly heats it. It must also be pointed out with regard to pressure methods that the system of pipes must be perfect, the slightest pinhole being a very real defect.

Electric light owes its popularity and adoption to the absence of the two great objections to gas, and also to its cleanliness and the ease with which it can be switched on and off and its general usefulness. Great care must be taken to replace lamps as soon as they show signs of wearing out. Neglect of this matter causes great inconvenience to the worker, not only with regard to his work but also in respect of his eyesight.

The laying of the wires in wood casing will most probably be prohibited by Government regulations owing to fires being caused from the fusing of wires, thus firing the casing.

The introduction of the metallic filament lamp has considerably helped electricity to meet the competition with gas.

The arc lamp is the cheapest form of electric lighting, but it is unsuited for small areas, being better adapted for spreading over a large space.

With regard to the cost of illumination by electric light, take the same basis of 1,000 candle power for one hour, with current supplied at 3d. per unit :

One unit of current will supply 32 8-c.p. glow lamps for one hour, or 16 16-c.p. Therefore
1,000 c.p. for one hour..... = 1s.

One unit will supply 24 25-c.p. metal filament Tantalum, for instance, lamps for one hour (about 1·7 watts per c.p.). Therefore 1,000 c.p. for one hour = 5d.

Arc lamps per 1,000 c.p. per hour = 1½d.

The following are a few simple rules of good lighting :

Light is the cause—illumination the effect.

Keep this motto always in mind : “Light on the object, not in the eye.” Therefore proper positions must be selected for the sources of light, so that it comes in the best direction and does not give rise to inconvenient shadows. The eyes must not be exposed to unshaded lights in the direct range of vision.

Don’t judge illumination by the brightness of the lamps. The printer must not think that because a lamp or light looks brilliant and glaring that it is giving a good light, it may be giving too much light in the wrong direction ; also, a well-shaded light may look dim, but in reality is giving a first-class light to work by.

Avoid excessive contrasts in cases of strong local illumination. Do not leave the rest of the room in darkness, but provide also a moderate general illumination for the whole room.

Use globes, shades or reflectors that diffuse the light evenly in all directions, and keep them clean. This also applies to the lamps, for dirt absorbs and wastes light.

Be sure that the illumination is sufficient, especially where work is actually done. Rooms with dark and dirty walls and ceilings require a greater illumination than those with white or light surroundings.

POWER.

The different forms of power which may be made available for the printer are :

Water ; Steam ; Gas ; Oil ;
Suction and Producer Gas ; Electricity.

Space will only allow of a brief reference to each. Special textbooks deal with these subjects in detail.

Water. The use of water power by means of turbines or water motors is a source of power practically unknown to printers in this country.

Steam. Until quite recent times the universal source of power in this country was the steam engine, either horizontal or beam, but this form of power has, however, been almost entirely superseded by the gas engine or the electric motor, except in a few very large offices demanding very heavy power, and therefore does not now need attention here.

Gas. The present generation of printers will remember the great improvements in the gas engine and their almost universal adoption in place of the steam engine. Amongst the advantages of the gas engine may be mentioned that no boiler is required, no coal or coal stores, ashes or ash heaps are necessary ; no stoking, expensive setting or chimney, or continuous attention required : thus an all-round economy is obtained in comparison with the steam engine. There are thousands in use, doing good work, the latest types running far more economically than the early makes.

Oil. This form of power, by means of the oil engine, has not made great strides. It is, however, a very useful form of power when local conditions favour it. The Diesel oil engine for large powers is very economical, with a lower consumption per b.h.p. than other oil engines.

Present-day competition lies between the suction or producer gas engine and the electric motor.

The cheapest form of power generated at the present time for printers is the gas engine running on suction for moderate power or producer gas for large powers, with two or more engines. There are, however, a large number of other points which need very careful consideration and expert advice before the printer decides which form of power to adopt.

Amongst these points are : Situation as regards source of supply, whether coal, oil, or a generating station ; space available ; nature of work to be done, i.e., whether a fairly continuous load or a very intermittent load.

Suction, Producer or Pressure Gas. The introduction of a great number of gas-producing plants has provided the printer with his cheapest form of power.

Pressure Plant. This type of plant is to be recommended when there are two or more gas engines or when there are engines and heating work. It is worked with anthracite, charcoal or coke, the consumption being about 13 lb. of anthracite or charcoal, or 14 lb. of coke per 1,000 cubic feet.

Suction Plant. These plants are in very general use. Worked with ordinary commercial anthracite, a small plant of under 50 b.h.p. will give a heat efficiency as high as 90 per cent. These plants are made from 10 b.h.p. upwards, the consumption of anthracite or charcoal being under 1 lb. and of coke a trifle over 1 lb. per b.h.p. hour.

Bituminous Plant. This plant, for making cheap gas without tar from bituminous coal, lignite and several other varieties of fuel, for both large and small powers, is a recent development. It is worked by suction : consequently there is no escape of smoke ; it is easy to work, and the cost of labour is about the same as an ordinary suction plant with anthracite. With a good gas engine under full load the consumption of fuel is a little over 1 lb. per b.h.p. hour. The stand-by losses are also very small, and good gas can soon be ready for the engine.

To give an idea of the cost of the different forms of power, from a pure power point, the following figures are for 10 b.h.p. for a continuous-run week of 50 hours :

Producer or suction	about 10s.
Gas, allowing 20 feet per b.h.p. per hour ...	= 20s. 10d.
Oil (with cheap oil)= $\frac{3}{4}$ d. per b.h.p. per hour =	31s.
Steam	= 45s.
Electricity, taking 9 units=10 b.h.p. @ $1\frac{1}{2}$ d.	
per unit.....	= 56s. 3d.
Or at 1d. per unit	= 37s. 6d.

Electric Motors. For some time past electricity has been employed for power purposes, but the early types of motors were deficient in many ways. They were regarded as little

more than substitutes for some other kind of power ; they were run at too high speeds, and were made to drive machines by means of the usual system of belting in connection with counter shafts. They had, on the other hand, the great advantages of compactness, a certain degree of facility of regulation, and cleanliness. They were also free from several nuisances attaching to most prime motors.

Modern motors combine these advantages, and include several others of value. Amongst these are greater compactness, more complete control, and durability. To these may be added a recommendation which is of the greatest importance. The earlier motors, as above mentioned, had counter shafting and belting ; the motor of the present day is attached either directly to the shaft of the printing machine or to a group of machines. The result is that the machine room which is electrically operated is free from belting and shafting, which are always more or less dangerous to operatives—especially to compositors who are called upon to make corrections to a forme lying on the machine.

An even greater advantage is that there is no loss of power, and no wear and tear of loose pulleys and shafting when the machine is not running. The motor may be placed under the machine or over it, on the ceiling. This is in striking contrast to the plan of having a vertical belt and shafting, with overhead hangers (which obstruct the light), when other power is used. The motor thus allows of good light, as well as steady power. The speed of the motor, and consequently that of the machine, is easily regulated, and a greater range of speed is possible than when belting and shafting are used. Each machine, again, is independent of the other machines. Hence there is economy of motive power, owing to the possibility of running any one machine without starting the loose pulleys of others. When the motor is attached to a cylinder machine, it becomes part of the machine, which is then an absolutely self-contained piece of mechanism. It can be run and controlled by the feeder, and with nicety and precision. He stands at one side and feeds, while the motor at the other side drives the machine. It has to be remembered, also, that a large percentage of the working time of a machine is lost in making ready while power is running,

whereas electric motors attached to individual machines do not cost anything when the machine is idle. Machines, too, may be run at different speeds, according to their capabilities and the class of work which is being done.

It has been calculated that the loss of power caused by belting and shafting—for loose pulleys, belting and shafting run all the time even if nine-tenths of the machines stop—is at least 40 per cent. The electric motor gains, too, as compared with the engine, for a gas engine working on a fluctuating load is certainly inefficient. At three-quarter load the electric motor consumes about 3 per cent. more per horse power developed than at full load, but the gas engine takes 10 per cent. more. At two-thirds of full load, the motor takes 5 per cent. more electricity per horse power than at full load, whilst gas consumption in the engine increases over 20 per cent. per horse power. At half-load the motor is only 10 per cent. less efficient than at full-load, whilst the efficiency of the gas engine has fallen off 35 per cent.

Machines thus driven can be placed in positions which would not be possible with the ordinary shafting system. A breakdown of one machine causes less loss of time and inconvenience than under the old plan. The cleanliness of the installation, and freedom from oil falling from overhead bearings and spoiling paper, are also of consequence. In short, where there are many machines, miles of belting that keep out the light are done away with, and tons of noisy, dirt-making shafting and pulleys give place to almost noiseless motors. This benefits, directly or indirectly, everyone in the printing office to an extent which is only fully appreciated after actual experience.

In regard to cost, it may be stated that as a general rule the initial cost of the installation is less than that which is incurred when ordinary shafting has to be erected. Even if it were more, it would not furnish a valid argument against the use of electricity, because the greater efficiency and convenience of the latter reduce the first cost to insignificance.

A firm of printers who adopted the system of driving independent machines by separate motors, and who had 74 such motors at work, stated that the output from their office had increased at least 20 per cent. since the introduction of

electric driving. This increase of output was attributed to six different causes.

1. The readiness of an electric motor, as compared with other prime movers, to respond to any demand made upon it for power above its normal load.

2. Its uniformity of speed ensures more perfect register of the printed matter, and "wastes" are few.

3. The absence of spoilt sheets caused by drops of oil from the overhead shafting and bearings, or by dirt carried round by the belting.

4. The more accurate adjustment of speed which is possible with a motor (by means of a regulating switch) than with the usual three or four-step pulley for belt driving.

5. Electric driving of machines is so much steadier that they can be run at higher speeds without excessive vibration.

6. The main engine, which is usually a slow-running one, invariably decreases its speed somewhat when there is a sudden increase of load caused by more machines being started, or by the running machines happening to get into step and synchronising. In such cases the main driving belt is sure to slip.

As to the amount of horse power required to drive different sizes of printing machines, much depends, of course, on the weight and age of the machines, and the form of driving gear adopted. The following may be regarded as a safe guide when machines are in good condition :—

Double Demy Wharfedale, 3 h.p. required,

Royal	„	2½	„	„
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Demy	„	2	„	„
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Crown	„	2	„	„
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Folio Demy	„	1	„	„
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„ Crown Platen		½	„	„
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„ F'cap	„	½	„	„
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other sizes *pro rata*.

CHAPTER XXXIX.

COMPANIONSHIPS ; DUTIES OF THE CLICKER ; THE CHAPEL.

IN large book printing offices the compositors often work in groups, under the direction of one of their number, who is called the clicker. This plan saves the employing firm much time that would otherwise be occupied in keeping accounts of the cost of work, as the clicker makes up an aggregate bill for the whole of the work done under his direction, and settles the wages due to each individual. It also tends to securing uniformity in the style of the work, as all the compositors take their orders from one man. It also promotes expedition, as the clicker can much more economically execute certain operations for the whole of the men than could be done if each of them temporarily suspended the work of composition to do such things for himself.

The duties of the clicker vary in different establishments, but they are mainly these :—

1. To receive copy from the overseer, and with it full instructions as to the style of the work to be done, such as the type to be used, the dimensions of the page, and details as to head lines, etc.
2. To give out copy in portions to the compositors working under him, and to provide them with directions as to style.
3. To keep an account of the copy given to each man.
4. To superintend the making up of the work.
5. To book each man's work, wages, etc., in a ledger.
6. To produce a general bill, showing to the firm the exact total cost at which the work is produced.

Formerly nearly all book-work was done "on piece"; now this plan is, happily, seldom adopted in good book-work offices, especially in London.

When the piece system is in vogue, some other duties are thrown on the clicker. There is certain matter which is regarded as "fat," which ought to be equitably divided

amongst the compositors. The clicker sets up this fat matter, and adds it to the general bill, so that each compositor may have his share. This share is calculated according to the amount of work he has actually done as expressed in "hours." These are not hours of time. It is agreed that a given number of lines shall form a thousand ens, and that a certain number of thousands shall be equivalent to an hour. The number of thousands of ens set by each man is the number of hours' work for which he is entitled to be paid. The clicker, however, sets up the head lines and other incidental matter for making up the pages. There are white lines and blank spaces also, which would go to increase the profits of the compositor. These are all set by the clicker, and their value is divided in such a way that the man who has worked most "hours" gets his proportionate share of this fat.

In some houses the clicker has also to receive the wages of the whole of the compositors under him, and to divide the money amongst them.

The group of men working under the clicker is called the companionship—a word always abbreviated to 'ship.

There are different systems of managing 'ships, but space need not be occupied with them on account of the growing tendency on the part of printing firms to pay compositors on book-work, not by piece, but by time—that is, "on 'stab" or establishment wages.

In giving out copy the clicker has a rough blank book, and in it he enters the name of each compositor, with the number of the folios of copy he is given to set. This record is valuable in case of any pieces of copy being lost. It is also useful for reference if any compositor is so inefficient as to be much behind his companions in producing his share of the work. This tardiness might delay the making up. A man who is thus behind in his work is said to be "in the basket."

The Printer's Chapel. The term "chapel" applies to any formal meeting of journeymen compositors employed in a printing office, and not, as has sometimes been erroneously stated, to any part of the office or building.

In various printing houses codes of rules are in operation, for, amongst other things, the conduct of business at these meetings. The rules also exemplify the regulations deemed

necessary in an office for the maintenance of discipline and the protection of the interests of the men as between themselves. Although a tacit acceptance of the workmen's chapel rules is usually accorded by the firm, or "closet," as the seat of government in a printing office is called, the firm is not a party to the drawing up of such rules. As a matter of courtesy it is usual for the father of the chapel to submit to the employer, or his overseer, any new clauses which may from time to time be introduced by the chapel. Not infrequently the employer will suggest modifications, and in such cases due deference would be paid to them by the chapel; but it is to be understood that the rules of a chapel are made by the workmen and do not emanate from the employer, who, if he were called upon to draw them up, would perhaps omit the restriction of trade union clauses and make numerous other changes.

The custom as to apprentices varies in different establishments. It is usually provided that, for the better regulation of this establishment, all apprentices shall be liable to the rules (except those relating to the Society), and shall have the protection afforded by them in every case in which they can possibly be brought to meet their position. Apprentices in the last year of their time shall also have the privilege of attending all chapels connected with trade matters, but not for voting on any question. On the occasion of a young man coming out of his "time," he must wait upon the father and inform him of the circumstances.

CHAPTER XL.

APPRENTICES.

THREE kinds of apprentices are employed in the printing trade :—1. Indoor apprentices; 2. outdoor apprentices; 3. turnover apprentices. Until the year 1808 all apprentices were of the first class, and were so known because they lived in their master's house, submitted to his domestic discipline, and generally recognised a sort of paternal authority, which he very generally sought to exercise. A change was made in the year named, when the employers found that there was some likelihood of a want of compositors arising, owing to the increasing demands of the newspapers. There thus came into existence the second class of apprentices, who lived with their parents or guardians, instead of under the roof of the employer. This new class is, of the two, now about the only class. Turnover apprentices are those who have begun their period of servitude with one master and are transferred, in order to complete it, to some other master. The rules of the London Society of Compositors prescribe that “all persons known by the name of turnovers shall be re-bound to an employer by means of a legal, or written, witnessed agreement within a period of one month from entering the office, and unless this agreement be produced at the completion of their servitude, they shall not be admitted to the society without the sanction of the committee.

Great caution should be exercised in the selection of an apprentice, and it is an encouraging sign of the times that much more attention is being paid to-day to the quality of the raw material offered as beginners in the trade. A good apprentice becomes a pillar to his master's house, while a bad one will often infect the flock, and disgrace everybody who has the misfortune to have to do with him. An apprentice should never be chosen until after at least a month's actual trial at the business. Preference should be given to a lad who

has respectable parents, and whose home is not too distant from his work. In the case of a lad having no father, then his mother, or guardian, may be a party to his indentures. The latter are sometimes executed in duplicate, the employer holding one part, and the parent or guardian the counterpart.

Forms of indentures are sold by all law stationers, but, as the document is a very important one to all parties concerned, it is hardly well to adopt a form which, being drawn up generally to apply to all trades, necessarily fails to touch on many of the special requirements of the printer.

The following is offered as a concise form of indenture, endorsed by a legal authority, and actually in use. It can be recommended for adoption, subject to necessary modifications to suit individual requirements, or any peculiar arrangements of a printing office.

This Indenture made the _____ day of _____
 One Thousand Nine Hundred and _____ Between _____
 _____ of _____
 County of _____ of the first part
 _____ of _____

of the second part (hereinafter called the Apprentice) and Douglas Gordon MacRae (hereinafter called the Master) now Managing Director of the Clement's Printing Works Limited Printers at Clement's House Clement's Inn Passage Strand in the County of Middlesex of the third part.

Witnesseth that the said Apprentice of his own free will and with the consent of the said _____ hereby binds himself as from _____ to the said Master during the term of SEVEN YEARS to learn the trade and business of Printing; And the said _____ hereby covenants with the said Master that during the said term the said Apprentice shall honestly faithfully and diligently serve and obey the said Master and shall not do or commit or suffer to be done or committed any waste damage or injury of or to the property of the said Master, and shall not unlawfully absent himself from the service of the said Master-and further that he the said _____ will pay to the said Master forthwith on the signing of this indenture the sum of _____ Pounds and further contracts for himself his Executors and Administrators that he or they shall and will at his or their own cost provide the said Apprentice during the said term with sufficient and suitable board lodging washing and clothes medicine and medical attendance and other necessities, and also that during the first three years of the said Apprenticeship the said Apprentice shall regularly attend in the evenings such suitable educational or technical classes as the said Master shall direct and the fees for which shall be paid by the said

As of further interest, here is a copy of a model apprenticeship indenture, compiled by Chas. T. Jacobi for the London Master Printers' Association.

(hereinafter called the MASTER), to be taught the art or craft of a _____ which he, the MASTER, now uses, and to serve him as an APPRENTICE from the day of the date hereof for the term of SEVEN YEARS thence next ensuing, during all which term the APPRENTICE doth covenant and agree with the MASTER, his executors, administrators, or assigns, that he, the APPRENTICE, shall faithfully serve his MASTER and keep his secrets and willingly obey all his lawful commands. And shall do no hurt or damage to his MASTER in his goods or estate, nor suffer any to be done by others, but shall forthwith give notice thereof to his MASTER. And shall not embezzle

or waste the goods of his MASTER, nor lend them to any person or persons whomsoever. And shall not buy or sell with his own goods or others during the said term. And the APPRENTICE shall, if practicable, attend any technical class or classes which may be held locally, but shall not join any body of volunteers or other organization of any kind without the express leave or sanction of his MASTER. And shall not contract matrimony, and shall not at any time depart or absent himself from the service of his MASTER without his leave, and shall be punctual at all times, and in all things as a good and faithful APPRENTICE shall behave himself to his MASTER during the said term. The working hours and holidays shall be regulated by the custom for the time being of the office or works of the MASTER.

AND the GUARDIAN, for himself, his heirs, executors, and administrators, doth hereby covenant and agree with the MASTER, his executors, administrators, or assigns, to find, provide, and allow unto his son the APPRENTICE during the term aforesaid good and sufficient board, washing, lodging, and apparel, and all other necessities in sickness and in health. And in case of the decease of the APPRENTICE during the said term pay and discharge the expenses of his funeral, and sufficiently indemnify the MASTER, his executors, administrators, or assigns, from and against all such expenses.

AND the MASTER, in consideration (of the sum of _____ and) of these premises, does hereby for himself, his executors, or assigns, covenant and agree with the GUARDIAN and APPRENTICE that he, the MASTER, will well and sufficiently teach and instruct, or cause to be taught and instructed, the APPRENTICE in the art or craft of a _____ and the MASTER shall, as far as possible, afford reasonable facility or convenience to the APPRENTICE for attending any local technical class or classes. And will weekly during the term of seven years, if the APPRENTICE shall so long live, or such part or parts thereof as the APPRENTICE shall perform and observe the covenants aforesaid, and shall not be prevented from transacting the business of his MASTER by reason of sickness, lameness, or other inevitable cause, pay and allow to the APPRENTICE the sums following :—

shillings per week for the first year ;
 shillings per week for the second year ;
 shillings per week for the third year ;
 shillings per week for the fourth year ;
 shillings per week for the fifth year ;
 shillings per week for the sixth year ;

shillings per week for the seventh and last year of the term,
 provided that the APPRENTICE shall attend regularly and punctually.

All time lost through illness or any other cause shall be deducted at the current rate of wages. And the MASTER shall have full power in his sole and absolute discretion to cancel this Indenture if the APPRENTICE do not on his part comply with the conditions set forth therein, or be found incompetent or incapable of being taught or instructed, or

shall be insubordinate or disobedient to the lawful commands of his MASTER.

IN WITNESS whereof the said parties to these presents have hereunto set their hands and seals the day and year first written.

(A)

(G)

(M)

Signed, sealed, and delivered by the above-named in the presence of

Several points in this second form are worthy of notice. The employer covenants to “teach and instruct or cause to be taught and instructed in the trade or business of a printer and all things incident thereto . . . to the best of his (the employer’s) knowledge and ability, and in such manner as he, the said master, now does and shall hereafter use or practice the same.” These terms meet difficulties which of late years have arisen owing to the increasing adoption of the principle of division of labour, consequent on the many ramifications of the art brought about by the use of machinery.

If the apprentice is disobedient or misconducts himself, the indenture may be cancelled. This is a clause which ought to find a place in all indentures. It has been held by lawyers that unless there be a stipulation to the same effect in the indenture, the apprentice cannot legally be dismissed even for gross misconduct or theft. The master in such a case has but two remedies. One is to chastise the apprentice, an expedient which is quite out of date, and one which it would be dangerous as a rule to adopt. The other is provided by the Employers’ and Workmen’s Act of 1875, under which the master can take the apprentice before a magistrate, and if he shows sufficient cause, the indenture may be cancelled. This course has been taken in some few instances.

It will further be seen from the form that the apprentice can be loosed from his bond if he shall be so inefficient as to give no promise of becoming a competent workman. This is owned as one of the principal evils in the printing trade—the fact that so many boys are apprenticed who are totally unfit for it. They are deficient in mental and physical qualifications. They take no interest in their work. After they have been for a short period at the business, they find this out for themselves, or the employer finds it out. Under old forms of indenture there was no remedy, no release from

a position as intolerable to the lad as to his master. Hence so many indifferent journeymen—men as profitless to themselves as to the employer.

Special attention should be given to the clause relative to the education of the apprentice. During his first three years it is obligatory upon him to regularly attend in the evenings such suitable educational classes as the master may select. Lest this should be in any way a burden upon the youth, the master usually covenants to pay the fees.

Under the new conditions of labour, boys find a fair amount of leisure, and if they were once imbued with a liking for study by the training to be obtained at the secondary or “continuation” schools during a period of about three years, the opportunity provided by the technical classes would be far more likely to be made the most of; and, indeed, a somewhat more advanced education than most printers’ apprentices obtain at the elementary schools should be insisted upon, because if no advantage is taken of the compulsory leisure which boys now have, they merely drift along during their term of apprenticeship and waste their golden opportunity. When they realise, on arriving at manhood, their educational deficiencies and the opportunities they have allowed to slip away, they find it too irksome to begin at the beginning, and usually abandon the task of improving themselves.

This clause applies not only to general elementary education, but to technical education. Day classes are now arranged in a number of the technical class centres for the particular purpose of instructing young apprentices. These are, of course, held with the concurrence of employers, who agree to allow their apprentices “time off” in order to obtain the desired instruction.

Very much of the success of the day or evening classes depends upon the facilities offered to students by employers and managers of printing establishments. Overtime and late hours soon interfere with attendance.

The time they are thus engaged is reckoned as if passed in the ordinary duties of the printing office.

The employing printer will be well advised, after having determined on a form of indenture, to have it printed for use, so as to ensure against error or variation.

CHAPTER XLI.

EXAMINATIONS OF THE CITY AND GUILDS OF LONDON
INSTITUTE.

ORIGIN of the Examinations. In 1868 a minute of the Committee on Education recommended the promotion of technical education throughout Great Britain, partly by the foundation of scholarships, to enable artisans to obtain scientific instruction as to the principles on which the practice of their trades or handicrafts was founded. It was, however, in the following year, 1869, that the subject of the technical education of British artisans first received anything like serious attention. A meeting was held at the Mansion House to consider the subject, and it was agreed that the Livery Companies of the City of London should take measures to promote this kind of education.

“Certain of the Livery Companies* of London, recognising the altered conditions of apprenticeship, were moved by their desire to devote a part of the funds which had been bequeathed to them, and which had accumulated in their hands, to the general improvement, by means of technical education, of the industries of the country, or of the special trades with which they severally were associated.” Several companies had, “by means of occasional lectures, by prizes, by exhibitions, and by other agencies, endeavoured to promote the interests of their several trades. It was, however, generally felt that these isolated efforts of individual companies, though productive of some good results, were not calculated to exert that beneficial influence on the education of the industrial classes of the country which might follow from their united action, and accordingly . . . a suggestion was thrown out that the Livery Companies of London might do well to combine for the purpose of developing a

*“A Short Notice of the City and Guilds of London Institute for the Advancement of Technical Education.”

general scheme of technical instruction, adapted to the requirements of all classes of persons engaged in productive industry. This idea took practical shape in the year 1877, when, at a meeting of the representatives of several of the principal companies, a committee was formed for the purpose of preparing a scheme for a national system of technical education."

Eventually the committee "prepared the outlines of a scheme . . . which provided for the foundation in London of a central institution for higher technical instruction; for the establishment of, or for assistance to, trade schools; for the conduct of examinations in technology; and for the subsidising of other institutions in London or in the provinces having cognate objects."

As early as 1876 the Society of Arts had instituted certain technological examinations, which did not, however, include printing. "In 1878 these examinations were transferred to the Association of Livery Companies then previously constituted as 'The City and Guilds of London Institute for the Advancement of Technical Education.'"

Such is the official account of the origin of the Institute. Of the four objects enumerated above—(1) the foundation of a central Institute; (2) the establishment or assisting of trade schools; (3) the conduct of examinations; and (4) the subsidising of technical institutions—the only one which has been carried out in the interests of printers as such has been the third: the institution of periodical examinations.

Each year there is published under the authority of the Institute a volume containing (*a*) the regulations for the examinations, (*b*) the syllabus of the next forthcoming examinations, (*c*) the questions put at the last previous examinations.

This volume sets out that the Institute "is prepared, under certain conditions, to register classes for instruction in technology and manual training, to inspect and report on the working of such classes, and to afford facilities for carrying out an examination in any of the subjects enumerated, provided a local committee undertakes to superintend the classes and to carry out the examination according to the rules laid down."

We may now point out the methods of the Institute, so far

as they relate to "the advancement of technical education" in the art of printing.

1. One or more examiners are appointed in London.
2. The examiners draw up a syllabus of subjects, and, later, a series of questions on those subjects.
3. Examinations are held in London and various centres. In printing, the candidates are required to write answers to these questions and also to attend practical examinations which are conducted at printing offices.
4. The papers of answers are sent from the different centres to the head office in London, and thence to the examiners.
5. The papers are gone through by the examiners, who award marks according to the ability shown, in their estimation, by the several candidates.
6. The candidates gaining the highest marks are awarded by the Institute authorities certain prizes and distinctions—these being distributed through the agency of the committees who have organised the classes.

Scope of the Examinations. The first examination in printing took place in 1879. The syllabus of subjects in which the candidates were to be examined was an extraordinarily comprehensive one. It included typography, lithography, and copperplate printing, type founding, stereotyping, electrotyping, process block making, ink making, brass type manufacturing, and even plate printing and etching on copper.

In 1883 the subjects of lithography, copperplate printing, and type founding—answering to entirely distinct trades—were divided. Lithography was made the subject of a separate examination for lithographers. This was a very important measure of reform. The syllabus was, however, still open to criticism, for it continued to ignore the system of division of labour which prevails in the trade. Compositors were expected to answer questions pertaining to the pressroom; machinists, who probably never set a type in the whole of their experience, were expected to exhibit an acquaintance with the duties of compositors. Apprentices in neither branch were taken into no consideration at all. If it were replied that the questions put were such that apprentices ought to be able to answer them, it was no credit to journeymen

to have successfully passed the examination. On the other hand, if the questions were real tests for a journeyman's knowledge, they were beyond the capacity of the apprentice.

In 1886 a further improvement was effected by instituting a "practical test" for compositors only. This consisted in giving out copy to be actually set up in the presence of examiners or inspectors within a definite space of time. The test was modified in 1894. Sheets of lithographed copy—facsimile of manuscript—were given out, and each candidate was required to compose it, to pull his own proof, and to distribute his own matter before leaving the room.

Another valuable change was made in 1893, when the syllabus of the following year's examinations was divided into three parts. One was intended to test "general" knowledge of the trade; another, knowledge of composing in all its branches, including both job and book-work, casting up, casting off, etc.; and the other, press and machine work. Students were to select their questions from Sections I and II or Sections I and III, according to the branch of the trade at which they worked—whether compositors or machine minders. The further improvement was provided for, in the shape of a more elementary examination, preliminary to that of the Ordinary Grade, "with the view of encouraging apprentices to take the complete course of instruction" in the subject of typography.

The Syllabus. The following is a textual copy of the official syllabus:—

CITY AND GUILDS OF LONDON INSTITUTE.
TYPOGRAPHY.

With the view to encouraging apprentices to take a continuous course of instruction in this subject, the examinations will be held in three grades, of which Grade I will be of an elementary character. No certificates will be given on the results of the examination in Grade I, but the list of names of the candidates who pass will be sent to the centre at which they were examined. Candidates may enter for the examination in Grade II without having passed in Grade I, but candidates for the Final Examination will be required to have previously passed in Grade II.

SYLLABUS.—GRADE I.

The examination in Grade I will consist of a paper of questions only in two sections, (1) for compositors and (2) for press and machine candidates, but candidates for either section will be expected to show some knowledge of elementary geometry and freehand drawing. The examination will include such subjects as the following :—

1. *Composing*.—Spelling ; punctuation ; appliances and materials used in case room ; technical terms generally ; composition of type metal ; qualities of good type ; description of the parts of a type ; weight of type and leads ; relationship of type bodies and their proportion to foot ; lays of the case ; characters in a fount ; casing letter ; attitude at frame ; rules to remember when setting ; habits to acquire and avoid ; rules for spacing and justifying ; rules for dividing words ; rules for distributing ; locking-up and unlocking ; casting-up matter ; readers' marks ; signatures and their use ; definitions of stereotype, electrotpe, woodcut and process blocks.

2. *Press and Machine Work*.—Sizes and subdivisions of papers and cards ; number of sheets in quires and reams ; use of signatures ; chases and furniture ; locking-up and unlocking formes ; simple schemes of imposition ; definitions of stereotype, electrotpe, woodcut, process block, three-colour process ; other technical trade terms and phrases ; descriptions of hand presses, platen and single-cylinder machines ; how to cover a tympan, cut out a frisket, prepare a platen for making ready, and dress a cylinder ; the constituent parts and working condition of rollers ; the care of inks ; washing of formes ; cleansing of wood, electro and process blocks ; mounting plates.

GRADE II.

The examination in Grade II will consist of a paper of questions, and of a practical examination for compositors to be held in a printing office. Candidates who enter under Section I must pass in both parts of the examination to obtain a certificate.

1. *Written Examination*. The examination will be divided into two parts, (I) for compositors and (II) for pressmen and machine minders. Candidates, according to their occupation,

may select their questions from Section I or from Section II. The questions will be founded on such subjects as the following :—

I. *Composing*. All the matter contained in the syllabus for Grade I ; production of book-work ; casting off MS. ; preliminary matter—how to set ; notes—how to set ; making up—various operations ; proportions of type to page ; measures for book-work ; making margin ; imposition—sheet and half-sheet work ; signatures ; various problems in type bodies ; point system ; display in its various phases ; use of ornament in display ; use of borders and vignettes, etc. ; classification of job work ; harmony of colour ; composition of colour work ; tint blocks ; sketching (rough) ; table work—how to set ; paper—machine and hand-made, various subdivisions, qualities and weights, equivalent weights.

II. *Press and Machine Work*.—Paper—machine and hand-made ; qualities of paper ; super-calendered and enamelled paper ; uses of wet and dry paper ; damping of paper and preparing it for working ; folding, stitching, stabbing and sewing ; counting, packing and keeping stock ; sizes of jobs ; schemes of imposition ; methods of drying printed work ; hot and cold pressing ; hot and cold rolling ; embossing ; quoins and their application ; the principal working parts of the various hand presses, platen, cylinder and perfecting machines ; making ready jobs and book-work on same ; making register ; use of points ; the composition and casting of rollers ; ink—medium and quick drying ; coloured ink ; suitable ink for certain papers ; underlaying and overlaying ; hard packing system in making ready—when best employed ; preparing overlays for woodcuts and process blocks ; imposing stereotype plates for press or machine ; varieties of mounting blocks and methods of mounting in use ; printing with bronze and leaf metal ; causes of slurring on press or machine ; electrotyping : stereotyping ; composition of ink ; harmony of colour ; rules for the selection of two, three and four-colour combinations ; mixing colours ; three-colour printing ; process blocks, their manufacture and preservation.

2. *Practical Examination (for compositors)*. The Practical Examination will consist mainly of composition from manuscript or printed copy supplied to the candidate. It is intended

to be a test, not so much of mere rapidity in “picking up,” as of general intelligence and of ability in setting any kind of matter that may fall in a compositor’s way, clean setting and good spacing being important; for instance, a piece of bad manuscript, a simply-displayed title page or job, a difficult piece of punctuation, a moderately complex table, classical phrases or proper names, or a foreign paragraph in fairly good hand writing. The Practical Test will take place at different centres throughout the country, at which the necessary arrangements can be made. The examination will be conducted, as far as possible, under the superintendence of expert assistants, who will be required to report to the chief examiners as to the manner in which the candidates have set about the several exercises given to them.

FINAL EXAMINATION.

Candidates for the Final Examination must hold a certificate in Grade II.

The questions will not be limited to any particular syllabus, but will be based upon the groundwork of the syllabuses for the previous grades, with a wide range of the whole subject of Letterpress Printing, and will include such subjects as the following :—

Construction and management of the hand press, and of platen, cylinder, perfecting, and rotary machines; making ready; rollers—their manufacture and treatment; the processes of stereotyping and electrotyping; process blocks—line and half-tone: their production and suitability for various classes of work; inks—black and coloured: treatment of; three-colour work; composing and distributing machines; power—steam, gas, and electric; shafting and gearing; the principles of estimating; charging-up work; the various essentials required for the production of a perfectly printed book; book-keeping for printers; general management; the warehouse; cost generally of plant, material, paper, etc.

FULL TECHNOLOGICAL CERTIFICATE.

Candidates will be required to pass the Institute’s Final Examination in Technology, and also, in general, an examination in Stage II, at least in two of the science subjects

included in the regulations. Certificates showing that a candidate has passed the examinations of the Board of Education in Geometrical Drawing, as well as in Freehand *or* Model Drawing, will be accepted in lieu of one of the Science Certificates.

EXAMINATIONS IN TYPOGRAPHY.

As typical of the questions set in the examinations in Typography held by the City and Guilds of London Institute, we give a copy of the papers set at the examinations in 1913, by the Department of Technology.

TYPOGRAPHY.—FINAL EXAMINATION.

1. You are requested to give an estimate of the number of pages a batch of copy will make ; the copy consists of several sheets, partly MS., partly reprint of varying measures and types, and partly typewritten. The paper on which it is drafted differs in size, and much of the matter consists of short questions and answers. State in detail how you would proceed to find the number of pages such copy would make.

2. Specify the kind of work you would set on the Monotype machine and what on a modern Linotype.

3. Name some of the defects common in Monotype casting, and give their causes and cure.

4. In printing from formes of Linotype slugs, which gives the least trouble, a 32-pp. forme or a 16-pp. one ? Give the reason.

5. By what processes would you reproduce the following for printing purposes :—Pen and ink drawings, wash drawings, silver prints, a pencil sketch with much shading ?

6. What are the causes of blistering of stereo flong ? State the remedy therefor.

7. Describe shortly the characteristics of the following papers :—Bond, cartridge, manilla, M.G. poster, “airlight” or “featherweight,” wove.

8. What are the standard weights per ream of the above papers in the following sizes, and their prices per lb. :—

Bond (Large post).

Cartridge ($22\frac{1}{2}$ by $35\frac{1}{2}$).

Manilla (double medium).

M.G. Poster (double crown).

“Airlight” or “featherweight” wove (quad crown).

9. Give a short description of the Falcon machine.

TYPOGRAPHY—COMPOSING.

GRADE II. SECTION I.

1. Four pages of a job set in 12-point solid, 36 ems wide and 44 lines in depth, has to be reset so that the matter may be 3-point leaded.

What size of type would you use for this, the dimensions of the pages to remain the same as before?

2. What weight of leads would be required for the above job?
3. Write out in full the following common contractions :—MSS., pp., ibid., min., 20° C., 40° F., i.e., fol.
4. A sketch 11 inches high by 9 inches wide is to be reproduced as a block for insertion in a column set 24 ems wide. What depth would you allow in the column for the finished block?
5. Draw a scheme of imposition of a forme of 32 pages to work and turn, consisting of the following oddments : 16 pages, 8 pages, and two others of 4 pages each.
6. A ream of printing demy weighs 24 lbs. What would be the equivalent weight of a ream of (*a*) royal, (*b*) foolscap, (*c*) double crown?
7. What are the qualifications required to make an efficient reader? Describe fully the work of passing a sheet of book-work for press.
8. Give a practical rule for the division of words. Under what circumstances is it inadvisable to divide words, and when may greater latitude be allowed?

TYPOGRAPHY.—MACHINE AND PRESS.

GRADE II. SECTION II.

1. How many reams of large post would you require to cut 10,000 quarto fly circulars?
2. How do you distinguish between the right side and the wrong side of the following classes of paper : Cream-laid writings, ordinary M.F. printings, azure-laid hand makes, and coloured cover papers?
3. Describe in consecutive order the operations of making ready, getting the register, and working off on a platen machine, of a circular in four printings, viz., black, red, tint and gold bronze; the black being the key forme.
4. When working off the second forme of a colour job you have difficulty in obtaining register owing to variation in the stretch of paper. How would you overcome this difficulty?
5. Describe the difference in principle between any rotary with which you are familiar and a stop-cylinder machine.
6. What is a mechanical overlay, and what advantages are derived by using it?
7. Draw a scheme of imposition of 24 pages, consisting of 16 pages of one job and 4 pages each of two others, work and turn.
8. What part of the cylinder upon which the sheets are stretched is turned to a smaller diameter than the flanges of the cylinder which run on the bearers? What would be the effect on the printed work if a greater number of sheets were stretched on the cylinder than is necessary to make up the difference between the two diameters?

TYPOGRAPHY.—COMPOSING.

GRADE I. SECTION I.

1. State shortly what are the necessary appliances and materials used in the composing room of a small jobbing office.

2. Describe the operation of distributing type, and state the advantages derived from careful distribution.
3. Write a list of any accents with which you are familiar, placing against each the name by which it is known.
4. What are split fractions? Describe the method of setting and justifying them.
5. How many 3-point leads are equal to an inch in depth, and how many 6-to-pica and 8-to-pica leads respectively are needed to make up 6 inches in depth?
6. What is the difference between a stereo and an electro? If one is superior in any way to the other, state in what its superiority consists.
7. Why are signatures used in book-work? On which pages should they appear in a book of 128 pages octavo, and in what position on the page are they usually placed?
8. Re-write, correct the spelling and punctuate the following extract:—
 “Ah! there is the thrush with its liquid note; there again is another old freind the blackbird, with its short snatchies of sweetest mellody. Now soft and low we here the coing of the doves, and loose it again in the joyfull chorous of a miriad morning songsters, and then begin all those indefinate sounds which make up the stir and hum of liveing, wakeing beings.”

MACHINE AND PRESS.—SECTION II.

1. What are the principal differences between an Albion and a Columbian press?
2. If the impression on a hand press is heavier on one side than on the other, what methods would you adopt to remedy the defect?
3. What is meant by “getting the register” on a hand press? Describe the operation.
4. How is the impression adjusted on a platen machine of the Cropper type? What rule should guide you as to whether you ought to alter the impression or not?
5. Give the sizes in inches of the following:—Double crown sheet, foolscap folio, demy quarto, royal octavo.
6. How many quarto circulars can be cut from three quires of large post?
7. Describe the operation of locking up a forme of four quarto pages in a chase fitted with crossbars. Draw a rough sketch of such forme, showing position of side and foot sticks.
8. How would you cleanse a forme of ordinary metal type after it has been worked off, and what preparation would you use for the purpose? Would you use the same preparation for cleansing rollers? If not, give your reasons.

CHAPTER XLII.

WAGES AND HOURS.

Compositors. In the Metropolitan district, which comprises a radius of fifteen miles from the General Post Office, compositors in Society houses, and some in others in which the union regulations are not accepted, are paid according to a variety of systems, some of which are highly complicated.

1. According to the length of the engagement, at a certain rate per hour or week. This kind of payment is called "establishment" (usually abbreviated to "'stab") wages.

2. According to the quantity of work done. This kind of payment is called "piece" payment. . (a) At a certain rate "per thousand" letters composed, each letter being supposed to be equivalent to an en ; (b) according to "galley" of an agreed number of lines ; (c) according to "hour." This method is followed only in Companionships.

Men working on piece are often said to be "on their lines," in contradistinction to being on "'stab."

Machine Compositors (or machine operators as they are often called) are paid on "'stab" or at a rate of per thousand ens ; that is, on piece.

Establishment Wages. Compositors on the establishment in the London district receive not less than 39/- per week of 50 hours. In provincial towns, as will be seen from the table given, wages vary from 24/- to 38/-.

Compositors, whether piece or establishment hands, if retained beyond a fortnight, have to receive and give a fortnight's notice prior to their engagement being terminated. Compositors called in to assist in the composition of book-work or jobbing, may take a casual engagement for not less than two days on the establishment at 10d. an hour, but not of a greater length than a fortnight without being entitled to a fortnight's notice, except when specially engaged for a particular job and retained for that job only, in which

case the engagement can be terminated on its completion without notice.

Overtime is paid at the rate of $3\frac{1}{2}$ d. per hour extra for the first three hours; after that time, but in any case after ten o'clock, from Monday to Friday inclusive, at 4d. per hour till twelve o'clock, after that at 5d. per hour. On Saturdays for the first three hours 4d. an hour, and after that time 5d. The charge for overtime is governed by the ordinary working hours of each office, and to commence in any case before 8 a.m., after 7 p.m., and after 1 p.m. on Saturdays; each day standing upon its own merits. Compositors called upon to work the whole of their dinner hour, receive 4d. extra. Compositors called upon to work overtime for more than three consecutive hours are entitled to half an hour for refreshment after each three hours have been worked without any deduction; that is, in a night's work of thirteen hours there are to be three intervals, each of half an hour, for refreshments. Fractions of hours are paid as complete hours. Lost time is deducted at the ordinary rate; but a compositor coming in more than half an hour late may be called upon to work the first hour of overtime the same day without charging extra, each day standing on its own merits.

Sunday work is paid at the rate of 8d. per hour extra, from twelve o'clock on Saturday night to eight o'clock on Monday morning. Where such work is continuous, compositors in no case to receive less than $\frac{3}{4}$ extra. Compositors called in at twelve o'clock on Sunday night are paid at the same rate; if at six o'clock on Monday, or any other morning except Sunday, at 4d. per hour extra.

Piece Wages. The London Compositors' Scale (1912) for book-work, "common" or ordinary matter, in roman type is shown on page opposite.

Reprints not in every respect exact reproductions of the originals are cast up $\frac{1}{4}$ d. per 1,000 extra.

Thin founts—that is those whose lower case alphabet when set up do not equal 12 of their own ems in width—are cast up at $\frac{1}{4}$ d. per 1,000 for every en below that standard.

The scales for dictionaries, gazetteers, grammars, catalogues, and for German, Greek, and other "foreign" alphabets, are higher than the above.

ABSTRACT OF THE LONDON SCALE OF PRICES FOR BOOK-WORK, 1912.

	COMMON	FOREIGN	DICTIONARIES.		GRAMMARS.		CATALOGUES.			GREEK.	
			English.	Foreign.	English.	Foreign.	Library.	Book-sellers.	Auctioneers.	Without accents.	With accents.
ENGLISH to } BREVIER }	$\begin{smallmatrix} d. \\ 7\frac{1}{2} \\ 8 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 8\frac{1}{4} \\ 9 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 8\frac{1}{4} \\ 9 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 8\frac{1}{4} \\ 9 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 7\frac{3}{4} \\ 8\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 7\frac{1}{2} \\ 8 \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 10 \\ 10\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} d. \\ 11\frac{1}{2} \\ 12\frac{1}{4} \end{smallmatrix}$	
MINION.....	$\begin{smallmatrix} 7\frac{1}{2} \\ 8\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	8	$\begin{smallmatrix} 9 \\ 9\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{3}{4} \\ 8\frac{1}{4} \end{smallmatrix}$			
NONPAREIL.....	8 $\frac{1}{4}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11 \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9 \end{smallmatrix}$			
RUBY.....	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 10 \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11 \end{smallmatrix}$	$\begin{smallmatrix} 9 \\ 9\frac{1}{2} \end{smallmatrix}$			
PEARL.....	$\begin{smallmatrix} 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{2} \\ 11\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11 \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{1}{4} \\ 12 \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11 \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{3}{4} \\ 11\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10 \end{smallmatrix}$			
DIAMOND.....	$\begin{smallmatrix} 11\frac{1}{4} \\ 12 \end{smallmatrix}$	$\begin{smallmatrix} 12\frac{1}{2} \\ 13\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 12\frac{1}{4} \\ 13 \end{smallmatrix}$	$\begin{smallmatrix} 13\frac{1}{4} \\ 14 \end{smallmatrix}$	$\begin{smallmatrix} 12\frac{1}{4} \\ 13 \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{3}{4} \\ 12\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 12\frac{1}{4} \\ 13\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{1}{2} \\ 12 \end{smallmatrix}$			
ENGLISH to } BREVIER }	$\begin{smallmatrix} 6\frac{1}{2} \\ 7\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{1}{2} \\ 8\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{1}{2} \\ 8\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{1}{2} \\ 8\frac{1}{4} \end{smallmatrix}$	7	$\begin{smallmatrix} 8 \\ 8\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 6\frac{3}{4} \\ 7\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{2} \\ 11\frac{1}{2} \end{smallmatrix}$	
MINION.....	$\begin{smallmatrix} 6\frac{3}{4} \\ 7\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8 \\ 8\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{3}{4} \\ 8\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{3}{4} \\ 8\frac{1}{2} \end{smallmatrix}$	7 $\frac{1}{2}$	$\begin{smallmatrix} 8\frac{1}{4} \\ 9 \end{smallmatrix}$	$\begin{smallmatrix} 7 \\ 7\frac{1}{2} \end{smallmatrix}$			
NONPAREIL.....	$\begin{smallmatrix} 7\frac{1}{2} \\ 8\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{4} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	8	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 7\frac{3}{4} \\ 8\frac{1}{4} \end{smallmatrix}$			
RUBY.....	8	$\begin{smallmatrix} 9\frac{1}{4} \\ 10 \end{smallmatrix}$	$\begin{smallmatrix} 9 \\ 9\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 10 \\ 10\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9 \\ 9\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{1}{4} \\ 8\frac{3}{4} \end{smallmatrix}$			
PEARL.....	$\begin{smallmatrix} 8\frac{1}{2} \\ 9\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{3}{4} \\ 10\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{4} \\ 11\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 9\frac{1}{2} \\ 10\frac{3}{4} \end{smallmatrix}$	9	$\begin{smallmatrix} 10 \\ 10\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 8\frac{3}{4} \\ 9\frac{1}{4} \end{smallmatrix}$			
DIAMOND.....	$\begin{smallmatrix} 10\frac{1}{2} \\ 11\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{3}{4} \\ 12\frac{1}{2} \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{1}{2} \\ 12\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 12\frac{1}{4} \\ 13\frac{1}{4} \end{smallmatrix}$	$\begin{smallmatrix} 11\frac{1}{2} \\ 12\frac{1}{4} \end{smallmatrix}$	11	$\begin{smallmatrix} 12 \\ 12\frac{3}{4} \end{smallmatrix}$	$\begin{smallmatrix} 10\frac{1}{2} \\ 11\frac{1}{4} \end{smallmatrix}$			

Reprints not in every respect exact reproductions of the originals are cast up $\frac{1}{4}d.$ per 1,000 extra; Reprints with MS. insertions, $\frac{1}{2}d.$ per 1,000 extra. Stereotyped matter with high spaces is cast up $\frac{1}{4}d.$ per 1,000 extra; stereotyped matter with low spaces is cast up $\frac{1}{4}d.$ per 1,000 extra. Thin founts are cast up $\frac{1}{4}d.$ per 1,000 extra for every en below 12 ems of their own body. Bastard founts of one remove are cast up to the depth and width of the two founts.

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This scale is modified in a variety of ways. Pamphlets, for instance, are paid 1/- per sheet extra ; bottom and side notes carry special payments ; so do tabular, table work, and column work ; slip matter has also extra prices. These are all set out in the Scale, but the system of charging would occupy too much space to be epitomised here. Happily piece payment—the occasional source of much misunderstanding, and which has always had an adverse tendency in encouraging inferior work—is being gradually superseded by time payment.

News Work. Newspapers, or periodicals partaking of the character of newspapers, composed in London, are charged thus, per thousand ens :—

Size of Type.	Morning Papers.	Evening.	Weekly, and wider intervals.
	d.	d.	d.
Minion and larger }	9	8½	8½
Minion and Nonpareil }	9½	9	9
Emerald ...	9½	9	9
Nonpareil ...	10	9½	9½
Ruby	10½	10	10
Pearl	11	10½	10½
Diamond ...	13	12½	12½
Per Galley	s. d. 3 10	s. d. 3 7	s. d. 3 7

Engagements on daily papers are of two kinds : (1) Regular hands, who are secured two galleys per day, and as much in addition as the requirements of the paper will admit of ; (2) assistants (commonly called “grass hands”), who are secured two galleys each time of working. Other rates will be found in the scale already mentioned.

We may add to the above extracts the advice that when engaging a new hand, in whatever department of the office, it is desirable that the employer, or his manager or overseer, should explicitly state the terms of the engagement, and inform him of the regulations of the office as regards meal-times, lost time, holidays, closed days, and in fact on all points liable to give rise to litigation, if not rightly understood at the outset.

Meal-times. The hours of meals are usually the same in all departments. In some houses, however, tea-time is disallowed in the machine room, and in place thereof this department is closed half an hour earlier than the others; the object being to save the loss of time in washing up, etc., when the machines are stopped half an hour for tea.

Closed Days. In regard to payment for holidays and days when the office is closed a difference of custom prevails. In some houses these days are deducted. They amount to seven days per annum, viz., Christmas Day, Boxing Day, Good Friday, Easter Monday, Whit Monday, August Bank Holiday, and the Wayzgoose day. Attention should be drawn, at the time of engagement, to this custom, and this is best done by having printed announcements relating to all departments always exhibited in the general overseer's room, and that referring to each separate department posted up near the desk at the head of that department.

Machine Compositors. All skilled operators in London Society houses must be compositors, and members of the London Society of Compositors.

The Scale provides for work at three different machines :— the Linotype, the Hattersley, the Empire. As neither of the two last named is now in operation, it is not necessary to occupy space with their rates. The proportion between Linotype rates and those for type-setting machines may be roughly gathered from the prices of book-work.

DAILY PAPERS. LINOTYPE.

$3\frac{1}{4}$ d. per 1,000 ens for day work in evening paper offices; $3\frac{1}{2}$ d. per 1,000 ens for work done in morning paper offices; $\frac{1}{4}$ d. per 1,000 ens extra on all types above brevier. Matter requiring two bars to complete one measure (not being tabular matter) to be charged one-third extra; three or more, one-half extra.

WEEKLY PAPERS. LINOTYPE.

$3\frac{1}{8}$ d. per 1,000 ens; $3\frac{1}{4}$ d. per 1,000 ens for all types above brevier. Matter set to less than 20 ems of its own body, or more than 24 ems pica in type below bourgeois, to be charged $\frac{1}{4}$ d. per 1,000 ens extra. Matter requiring two bars to complete one measure (not being tabular matter) to be charged one-third extra; three or more, one-half extra.

BOOK-WORK. LINOTYPE.

3d. per 1,000 ens; $3\frac{1}{8}$ d. per 1,000 ens for all types above brevier. Matter set to less than 20 ems of its own body, or more than 24 ems

pica in type below bourgeois, to be charged $\frac{1}{4}$ d. per 1,000 extra. Matter requiring two bars to complete one measure (not being tabular matter) to be charged one-third extra; three or more, half extra.

Two other composing machines now in use are the Monotype and the Typograph. There is no piece scale for this class of composition. The minimum rate for the operator is £2 5s., and the hours 48 per week—these conditions corresponding with the 'stab' conditions for Linotype operators.

PRINTING MACHINE MANAGERS.

From time to time agreements have been arrived at between the Master Printers and Allied Trades' Association and the Printing Machine Managers' Trade Society, the latest terms of agreement, dating June 7, 1905, also affecting Rotaries not actually operating on newspaper work. At a more recent date, May, 1913, a special agreement dealing with newspaper Rotary machines was arrived at between the Newspaper Proprietors' Association and the above trade society, the terms of this agreement forming an appendix to the terms affecting ordinary flat printing machinery. The terms of agreement were accepted and in operation from 1905, a reduction at that time from 54 to 52½ hours per week. Although not actually agreed upon by the Association of Master Printers, from February, 1911, in 90 per cent. of the offices employing members of the Machine Managers' Trade Society, 50 hours per week had obtained. In a few instances the 48-hour week is in operation. The general clauses of the 1905 agreement, with a slight amendment affecting jobbing and temporary employment, are in operation at the present time and include the following:—

That the minimum wage be 39/- per week.

That the minimum wages for a machine manager, having in his charge two single-cylinder machines up to and including quad crown size, to be 41s. per week.

All machines above quad crown to be one man one machine.

Machine managers in charge of machines with feeder attachments to be paid 2s. extra.

That machine managers called upon to work the ordinary dinner hour be paid 4d. extra, and go to dinner not later than 3 p.m.

That machine managers be paid, in addition to their ordinary

rate of wages, the following rates. Fractions of hours counting as complete hours :—

If working not later than twelve o'clock 4d. per hour extra, with an interval of half an hour for refreshment, after three hours of overtime have been worked, provided work is continued beyond the three hours. The time for such half-hour's refreshment to be fixed by mutual agreement. Thus, if the ordinary time for leaving off work be 7 p.m., no time will be allowed for refreshment unless working beyond 10 p.m.

TEMPORARY OR CASUAL EMPLOYMENT.

There shall be no hour rate, but a rate of 9s. for one day (hours of the house consistent with the uniform hours of the trade) ; 8s. 6d. per day if minimum of two consecutive days ; 8s. per day if more than two days—Saturday a half-day, i.e., Thursday, Friday and Saturday to count as two and a half days. This lower rate of 8s. only to be applicable if employment is on three, four, or more consecutive days.

From the above it will be seen that the casual worker, if employed for one complete working week, Saturday half-day inclusive, would receive £2 4s. If employed for Saturday morning only, the minimum to be 4s. 6d.

Casual Overtime.—Employment to be at similar rates with the ordinary overtime rate and a minimum of 8s. 6d.

Casual Night Work.—A single night to be 15s., exclusive of the customary refreshment times. Two nights to be considered as separately contracted for nights, in which case the 15s. will also apply. Twelve hours with customary refreshment times, to be considered a night's work.

Night Shifts.—A night shift may be established for three complete nights per week at 14s. 6d., or four nights per week at 13s. 6d. These need not be consecutive nights, but specified on arrangement of night shift. Twelve hours, with customary refreshment times, to be considered a night's work.

As no agreement exists for half-days other than Saturdays, the arrangement, therefore, for consecutive days means full days at the rates specified in clause 2.

Rotaries (other than Daily Newspaper work).—The minimum rate of wages for men in charge of Rotary machines to be £2 5s. per week of $52\frac{1}{2}$ hours.

Apprentices. In an office where only one journeyman is employed there shall be allowed one apprentice, and two

apprentices to four journeymen, provided such number of journeymen have been employed in the machine room six months. There must be three additional journeymen, subject to the foregoing regulations, for each additional apprentice. A special agreement has been made for apprentices on newspaper Rotary machines, see special agreement, page 356.

In view of the special newspaper agreement the following applies to flat machinery only, and rotary work not designated newspapers :—Sunday work be paid for at the rate of 8d. per hour extra beyond the ordinary pay, from twelve o'clock Saturday night, till eight o'clock Monday morning, when such work is continuous ; the machine manager in no case to receive less than $\frac{3}{4}$ extra, the same rule to apply to Christmas Day, but not to apply to weekly newspapers, the getting out of which regularly enters into Sunday mornings. Machine managers, called in at twelve o'clock on Sunday night, to be paid at the eightpenny rate ; if at six o'clock on Monday morning, at the fourpenny rate, this to apply to any morning except Sunday.

The following supplementary clause has since been agreed to :—

That the engagement of machine managers at one office at four nights per week, for not less than one consecutive week, shall constitute a night shift, and may be paid for at the rate of 4d. extra per hour upon the basis of 40/- per week. No stipulation with regard to notice exists ; this should be made a subject for mutual agreement prior to engagement.

It has not been found practical to draw up a “ piece ” scale for various reasons. Amongst them are the limitation upon output caused by the kind of engine employed, whether steam or gas ; the width of straps, whether immediate or intermediate, and their looseness or tightness ; the capacities of layers-on, and the general system of management prevalent in the machine room.

Most of the members of The Printing Machine Managers' Trade Society are in receipt of wages beyond the minimum rate, and some work, by arrangement, less than the maximum number of hours.

In non-Society houses the wages of machine managers are not fixed by any general scale, being arranged between employer and employé in each case.

Layers-on or Feeders are paid by day or hour, according to their capabilities. They are usually designated “printers’ labourers,” and they have no trade union organisation like those of the compositors and machine managers.

Pressmen are either paid establishment wages or on piece. The latter is often reckoned “per token,” *i.e.*, 250 impressions, but more usually now at per thousand impressions. The number of men who work exclusively at the hand press is now so small, that it is not necessary to occupy space with the scale, which is variable, according to the quality of the work required from them.

The following supplementary agreement was made between the Master Printers’ Allied Association and the Trade Society in 1909 :—

No member of the society to be employed for a period of 24 hours without a break of one day ; but if in case of necessity he is kept for an additional three hours, making 27 in all, the overtime rate shall continue during such time. In all cases where a member has been on for at least 24 hours, and there is work to justify it, another machine manager shall be employed during his absence.

A memorandum of agreement made 9th May, 1913, between the Newspaper Proprietors’ Association, Limited, and the Printing Machine Managers’ Trade Society, respecting the minimum rates of wages for Rotary machine managers on daily newspapers includes the following conditions :—

DAY WORK—48-HOUR WEEK :—

	£	s.	d.
One roll rotary, irrespective of width - - - -	2	5	0
Two rolls, irrespective of width - - - -	2	12	6
Three rolls or more, and over three plates wide - -	2	15	0

NIGHT WORK—48 HOURS (6 nights of 8 hours, Sunday to Friday inclusive) :—

One roll rotary, irrespective of width - - - -	3	5	0
Two rolls, irrespective of width, or three or four rolls two plates wide - - - -	3	12	6
Three rolls or more and over three plates wide - -	3	17	6

The proprietor shall decide as to the number of men necessary, and should an assistant machine manager be required he shall be paid £2 2s. for day work and £3 for night work ; but whether an assistant is required or not, the machine manager shall remain responsible for the working of the machine in every respect.

Overtime shall be paid at the rate of fivepence per hour on the above rates of wages.

No extra charge is to be made for Sunday, Christmas Day, or Bank Holidays.

Jobbing hands to be paid overtime rates as defined above, with a minimum of five hours for day work or a whole night ; and for Sunday work tenpence per hour above the ordinary day rate to be paid, with a minimum of one day.

Machine managers shall be paid 6s. 8d. for a half-day job of five hours on an evening paper.

During the time employed, machine managers may be called upon to produce any class of publication or printed matter required by the management.

Where five or fewer journeymen are employed in a newspaper office one apprentice shall be allowed, with one additional apprentice for every other five journeymen, but they shall not be less than sixteen years of age when bound, the term of the indenture being five years, and it is deemed desirable that the maximum age when bound be twenty-five years.

HOURS AND RATES OF COMPOSITORS' WAGES—HAND AND MACHINE.

The following tables of recognised rates in the principal towns in the British Isles are extracted from the latest returns. Constant changes are, however, being made in the direction of shorter hours and increased wage rates.

SCOTLAND.

TOWNS.			Case Hours.	Rate.	TOWNS.			Case Hours.	Rate.
Aberdeen	..	..	50	34/6	Glasgow	..	..	50	36/-
Airdrie	..	..	54	32/6	Greenock	..	..	50	36/-
Alloa	..	..	50	28/-	Hamilton	..	..	51½	32/6
Alva	..	..	50	28/-	Hawick	..	..	54	25/-
Arbroath	..	..	54	27/-	Inverness	..	..	50	28/-
Ardrossan	..	..	49½	31/6	Irvine	..	..	52	28/6
Ayr	..	..	52	31/6	Kelso	..	..	53	25/-
Banff	..	..	51	27/-	Kilmarnock	..	..	50	31/6
Bathgate	..	..	52	30/-	Kirkcaldy	..	..	50	29/-
Dumbarton	..	..	52½	33/-	Leith	..	..	51	31/6
Dumfries	..	..	52½	30/-	Loudoun	..	..	52	30/-
Dundee	..	..	49	33/4	Oban	..	..	52	30/-
Dunfermline	..	..	50	31/-	Paisley	..	..	50	36/-
Edinburgh	..	..	50	32/-	Perth	..	..	50	31/-
Elgin	..	..	54	27/-	Rothesay	..	..	51	27/-
Falkirk	..	..	50	30/-	St. Andrews	..	..	51	28/-
Forfar	..	..	50	27/-	Stirling	..	..	51½	30/-
Galashiels	..	..	53	27/-	Stranraer	..	..	51	29/-

The Linotype rates vary from 37/6 in Dundee to 38/6 in Aberdeen and 40/- in Glasgow. A uniform 48 hours is observed for Linotype workers.

ENGLAND AND WALES.

TOWNS.	Case Hours.	Rate.	Lino. Hours.	Rate.
Accrington	51	32/6	48	36/6
Ashton-under-Lyne	51	34/8	48	40/-
Stalybridge				
Dukinfield				
Mossley				
Barrow	52	33/-	48	36/-
Bath	52	30/-	48	34/-
Birmingham	51	36/-	48	40/-
Blackburn	51	33/6	48	37/6
Blackpool	51	32/10	48	37/-
Bolton	51	35/-	48	40/-
Bradford	51	34/-	48	40/-
Brighton	51	30/-	48	32/6
Bristol	51	33/-	48	37/3
Burnley	51	32/6	48	37/-
Burton	51	31/6	51	40/-
Bury	51	32/6	48	38/-
Cardiff	51	35/-	48	41/-
Carlisle	51	30/-	51	38/-
Carmarthen	51	28/-	48	32/-
Chester	51	31/6	48	34/-
Chesterfield	51	30/-	48	36/-
Cheltenham	52	28/-	51	35/-
Darlington	51	32/-	51	40/-
Derby	51	34/-	48	38/-
Doncaster	51	32/6	48	36/6
Exeter	52	26/-	51	30/-
Folkestone	52	24/-	51	32/-
Guildford	52	30/6	48	34/6
Halifax	52	32/6	48	37/-
Huddersfield	51	31/-	48	36/-
Hull	51	32/-	48	36/-
Hyde	51	34/8	48	39/-
Ipswich	52	29/-	48	35/-
Isle of Man	51	30/-	50	35/-
Kettering	52	30/-	48	36/-
Leamington	51	30/-	48	34/-
Leeds	51	35/6	48	42/-
Leicester	51	36/-	48	39/6
Liverpool	51	38/-	48	44/-
London	50	39/-	48	45/-
Macclesfield	51	31/-	48	35/-
Maidstone	53	30/-	48	34/-
Manchester	50	38/-	48	42/6
Middlesbrough	51	33/-	48	38/-
Middleton	52	31/6	48	36/-
Newcastle	51	35/-	48	40/-
Northampton	51	33/-	48	37/6
Norwich	52	28/-	48	32/-
Nottingham	51	35/6	48	39/-
Oldham	51	34/-	48	38/6
Oxford	51	30/-	48	33/6
Plymouth	52	30/-	48	34/-
Potteries	51	32/-	48	36/-
Preston	51	35/-	48	40/-
Reading	51	29/-	48	34/-
Redhill	51	30/-	52	35/-
Rochdale	51	34/-	48	38/-
Rotherham	51	34/-	48	40/-
Scarborough	51	30/-	48	34/-
Sheffield	51	35/-	48	42/-
Southport	51	34/-	48	38/6
Stafford	51	30/-	51	37/6
Stockport	51	33/9	48	39/-
Sunderland	51	34/6	48	39/-
Tunbridge Wells	51	30/-	48	32/6
Walsall	51	33/-	48	37/-
Warrington	50	30/-	..	..
Wigan	51	33/6	48	40/-
Wolverhampton	51	34/-	48	38/6
Worcester	51	30/-	48	36/-
York	51	32/-	48	36/-

IRELAND.

TOWNS.	Case Hours.	Rate.	TOWNS.	Case Hours.	Rate.
Banbridge	52½	25/-	Limerick	51	31/-
Belfast	51	35/-	Londonderry	51	29/-
Cork	51	34/6	Newry	51	27/6
Dublin	51	35/-	Sligo	51	26/-

NON-UNIONIST OFFICES.

In offices wherein trade union regulations are not recognised rates of wages and hours of work are settled by private agreement between employers and employed. Generally speaking, the wages in such offices are similar to those of the unionist offices, but tend to be lower. The hours worked are also similar. Owing to the absence of organisation on the part of men working in non-Society offices, authentic particulars in regard to wages, etc., cannot be obtained.

CHAPTER XLIII.

ESTIMATING.

ESTIMATING—that is, supplying to a customer, or a prospective customer, the cost of a given job—is now almost invariably called for before work is put in hand. In regard to the great majority of jobs this requirement cannot be considered as unreasonable. The customer has a right to know what he will be required to pay for what he wants, and done in the style he selects. The estimate will show him whether he can afford the work; whether the number of copies he proposes is beyond his means; whether the style he has chosen is too extravagant, and other things.

“Cutting” Estimates. Although the making of estimates is a matter of individual right, it can be made the pretext for much great general wrong. The printer who estimates £20 for work usually or generally done at £30, does not only injure his brother printer who has done the work at the last-mentioned price, but he strikes a blow at all the other printers in his district. He encourages his customers to distrust the fair dealing of other printers. This suspicion is often highly unjust. The undercutter encourages a system of reprisals, as well as of competition, from which he is sure to suffer eventually.

A young employer, or one not well versed in making estimates, cannot safely deviate from the established rates of the trade. He may think, as many journeymen compositors do think, that a sum added for profit equal to 80 or 90 per cent. on the compositor's charge for the piece of work is altogether too high. He thinks so only because he does not know the magnitude of other items of expense necessary for the perfection of the work as represented by the number of lines it contains. He under-rates these expenses. Is it wise or safe for any young man to think he can prosper by prices that are refused by the great majority of the trade?

Errors in Estimating. The commonest error is that of over-rating the performances of men and machines. There are many compositors who can set more than 2,000 ens per hour, but we know also that the average performance of an office of 50 men, on book or jobbing work, is less than a 1,000 ens an hour. There are cylinder machines that have done, and can do, on long runs, 10,000 impressions in a day of ten hours, but we know also that the average performance of cylinder machines in jobbing offices, on long and short runs, rarely exceeds half that number of impressions a day, and oftener falls below that number. Estimates for time work should be based not on the performance of the expert, but on that of the average workman; not on the number of sheets done on one exceptional day, but on the average number done in the past year. What has been is that which will be.

There have been many essays written on the cost of doing printed work, which well deserve study, but every printer of even one year's experience can learn a wiser lesson from the study of his own account books. If he will take the trouble to find out how many reams of presswork he did the preceding year, and what he got for it, and what was the expense account of his machine room; how many ens he set, how many hours of time work he charged, and what he got for it, and what the expense of his composing room was—if he will do this carefully, honestly reckoning interest and depreciation, he will learn more of the cost of printing than he can get from any treatise on the subject. After this has been done, he may possibly think that he can do better next year. Perhaps he can, but not much better. The conditions of work are inflexible. He certainly will not learn that he can do for £20 what others charge £30 for.

A printer should not make estimates for work that he cannot do. If he is not provided with the proper material, and has not had experience in certain branches of printing, he should not attempt to price them. It is always unsafe, and often unjust, to give prices for Greek, music, high-grade colour work, etc., on the supposition that these kinds of work are done or can be done at an imaginary rate. One should know, and not guess, what the rates are. Our art is now so complex, and has so many branches, that few, if any, offices

dare undertake all of them. Every sensible printer finds his advantage, not in getting together all the orders he can, but in getting only the work that he can do at a profit—work that he has facilities for, and that he knows how to manage. The tendency of the trade is to specialise. There are offices that do books only, others that do posters only, or job work only, or music only. It is well that there should be such divisions of work. The material and machinery for these and other branches of the art are expensive, and require special expertness. It is unwise for the average printer to meddle with the work of experts.

Estimates asked for by any customer on work done by another printer, with the plain and evident intention of finding a cause for an alleged unfairness of price should be declined. If, however, such a request should be pressed, tell the customer that his request may be laid before the local master printers' association, but only after the person who has done the work has had an opportunity to name and defend his price. It is not safe to criticise any price until one is in possession of all the facts. These facts the customer cannot fully know. The work itself, when done, does not say whether it was done by night or day, with little or with great alterations; but these and other conditions have influenced or controlled the price.

Estimates calling for detailed specifications of the separate value of the paper, composition, electrotyping, presswork, ruling, binding, etc., should always be refused. When the estimate is asked only for presswork, or for binding—the customer furnishing the rest—it may, of course, be granted. It is quite usual for publishers to supply plates and paper for a reprint. But an invitation to estimate for a book or pamphlet, and to give the value of each item, is unreasonable, and should always be refused. These details the customer has no right to ask for. One might as well ask from an engineer specifications of the labour in different parts of a machine. To be ready to give away these details to a customer is the surest way to provoke unfair competition. It often happens in tendering for work that a certain complete price is the lowest of three or more tenders. If this lowest tender gives the items, and if it contains one item that is higher

than others, the printer will be asked to reduce the price of that particular item.

Requests for estimates for printing known to have been done by a brother in the trade should be entertained with caution. An attempt should be made to discover why a change in the printer is desired. A consultation with this brother, or at least a notification to him that a change is to be made, is a fair and open procedure, which will in nearly every case remove any cause for dissatisfaction at the result, whatever that result may be.

Requests for estimates from unknown persons that call for tedious calculations, and that seem to be made to satisfy vague curiosity, should be regarded as professional work, to be duly paid for. The same remark will apply to many printers. It is not, to say the least, considerate to ask a brother printer to review an estimate, or to make a new estimate, when the work called for will take one hour or more of close calculation.

The estimate of the cost of work is accordingly a calculation based upon the expense of producing it. To this expense has to be added a certain sum for profit. This seems simple to the inexperienced, but those whose duty it is to calculate the cost of work know that there is no more difficult problem. There are to be taken into consideration a great number of details, many of them not apparent until after much study and close observation. Even after they have been enumerated, further matters, dependent upon the circumstances of particular firms—their resources, their position, the prevalence or otherwise of competition—will often modify the calculation. No hard and fast line as to profit can possibly be laid down with any advantage.

What the printer has to do is first of all to ascertain personally, or through a trusted and competent employee, the actual net cost of the job, and then to use his own judgment as to the sum to be added for profit. If his estimate is too low, he will simply lose by the job, and unless in very exceptional cases, had better be without it. If the estimate is too high, he will almost certainly fail to obtain the order, and may be injured by the impression thus created that he is not able to work on as economical lines as his competitors. What

has to be discovered is the mean between the two—the line of safety which lies between the extremes.

The only really safe method is to adopt an approved costing-out system of charging and estimate accordingly. Such a system is described later.

Now how to calculate the real instead of the apparent or conjectural cost of producing any particular piece of printing.

GENERAL NOTES ON ESTIMATE PREPARING.

In nearly all large printing offices some member of the firm, or a clerk possessing the necessary knowledge of the technicalities of the trade, is more or less exclusively occupied in computing the cost of work. Proprietors or managers of comparatively small businesses have seldom, however, sufficient leisure to study this important subject. The result is that too often many details of expense are overlooked, and the general principles on which percentages should be added are imperfectly grasped. Many businesses indeed are conducted at a loss owing to their owners being unable to estimate accurately the importance of many items which ought to be taken into the most careful consideration.

The following general suggestions are intended to assist the printer in discharging this duty. If intelligently and thoroughly carried out they will, we think, enable anyone who has had a year or two of experience in the printing business to “cost up” work correctly, and in a simple and expeditious manner.

The expenses of a printing business may be ranged under two headings:—First, those that can be naturally and directly apportioned to a particular department, and second, those on the contrary which appertain to the business as a whole, and cannot easily be separated or “dissected” and apportioned to any one department. The latter class may in general be termed establishment expenses.

The shortest method of computing establishment expenses is to reckon up the actual expenses of the previous year's trading. Having done so, it should be ascertained what proportion this total bears to the total labour costs of the year. By this expression is meant, not merely the net wages paid, but the total labour cost as shown by adding up the

whole of the cost tickets for the year down to the point at which the first total is taken. The proportion these expenses bear to the total labour cost would form the percentage to be charged for expenses on every job before profit is added.

By adopting this plan the items of labour cost can be compared with general results year by year. If needful it may occasionally be modified. The time required for this calculation will be comparatively small, when this system has been once started.

Wages. It is convenient to divide wages into two parts :— (1) Productive wages ; (2) non-productive wages such as establishment salaries. The productive wages are those of all the employees in the composing room, the machine room, the stereo room, the cutting room, and the warehouse, as well as overseers in all departments. The establishment salaries include all other wages and salaries, such as those of managers, travellers, clerks, etc.

To illustrate the working out of the method reference may be made to the “ Estimate Costing Sheet,” on page 380, and the items may be gone through seriatim.

In regard to the composing room, there should be taken the whole of the wages for a week, including those of compositors, readers, proof-pullers, overseers, apprentices, etc. If, however, there is much fluctuation from week to week in these particulars, the total of a year should be taken and a weekly average worked out. To this there should be added a certain amount for sundries, such as turps, lye, brushes, page cord, proof paper, ink, etc. These items should be added up along with wages. Next it should be ascertained what is the average number of hours worked in the week on composing (not distributing). In doing this fair allowance should be made for slack times, a point to which reference will again be made. If the total amount of the wages and sundries is divided by the number of hours, the result will give the price per hour which ought to be charged on the cost sheet for composition.

Proceeding to the machine room we here take the wages of all minders, feeders, sheeting girls, boys, etc., and including the man who looks after the gas engine, as well as the overseers of all the machine rooms. These are totalled up

for the week, or if there is much variation the average of the year has to be taken. To this sum have to be added items for repairs of machinery, roller composition, oil, turps, benzoline, lye, rags, etc.—all of which can be computed from the actual sum they cost in the previous year. There should be taken, on the other side, the number of hours that each of the machines work per week on the average. Here again it is necessary to make some allowance for slack seasons. When a safe number of hours has been fixed on, there has to be calculated a proportionate rate per hour for the different sized machines—a rate that will, in the aggregate, total up to the amount on the other side. This gives the price per hour proper to be charged on the cost sheet for each machine according to size. It is important to remember that it is not only the time the machine is running that has to be charged, but also the time spent in making ready, and cleaning up after the job is finished if in coloured ink. In the cost sheet adequate provision is made for charging for ink and bronze, paper, etc.; also any out-door charges for artists' work or engraving, binding, etc. Cutting should be dealt with separately, a charge being made in respect of it on all jobs requiring it. Under the item "warehouse" a charge should be made upon every job that will represent the cost of handling paper, packing, etc.

If all of these calculations have been made correctly, the precise amount of all wages (except establishment salaries) has been ascertained, and if the expense of materials, with the cost of work done outside, has been duly included, it remains to provide for what may be called establishment expenses.

Under the following heads may be included all establishment expenses :—

- | | |
|---------------------------------------|--------------------------|
| 1. Establishment salaries. | 8. Interest on capital. |
| 2. Rent, rates, taxes, and insurance. | 9. Stationery. |
| 3. Coal, gas, and water. | 10. Paper and string. |
| 4. Carriage. | 11. Bad debts. |
| 5. Postages and telegrams. | 12. Commission. |
| 6. Establishment repairs. | 13. Discount. |
| 7. Depreciation of plant. | 14. Travelling expenses. |
| | 15. Sundry expenses. |

These, as already mentioned, should be totalled up on the basis of the previous year's experience. The proportion this total bears to the total labour cost, as shown in the cost sheets, will give the percentage to be charged on costing for expenses.

Profit may then be added, and if the system has been correctly worked out, this will be net profit.

This system is, we consider, far more safe and reliable than the plan often advocated of simply adding to the cost of wages or materials an arbitrary percentage. The calculations above recommended are, on the other hand, based upon the peculiar conditions of individual offices. This recommendation can be carried out by any employer, and in doing so he will learn much that is useful about his own business and the manner in which he is conducting it. This, in itself, would be an advantage of the most important kind. For a similar reason we do not recommend the use of printers' ready calculated price lists. Their prices may meet the circumstances of some offices, but it is impossible that they should meet those of all offices. Hence there is much danger in using them. It is not only the safest plan but the most instructive for each printer to figure out for himself what he ought to charge for work. It ought not to influence him greatly whether other printers can do the work at a lower price than he can, or are able to obtain a higher price, except in so far as it may enable him to detect wherein he has erred in charging too much.

The estimate should be typed or written in copying ink, and copied in the usual way into a letter copying-book made of stout paper. On page opposite ~~is~~ a form which can be recommended. It is a sheet of large post quarto.

After the copying paper pages, at the end of the book there may be guard leaves, and on these may be pasted a cost or analysis sheet for the various jobs, numbered to correspond with their respective estimates.

The Counting House. This department brings together all the costs of work, and adds to them the general charges of the business. There may be the manager and the book-keeper, clerks, cost of correspondence, travelling expenses, subscriptions and charities, and there are all the expenses

Caxton Press, *No.*

Westminster, 19

ESTIMATE from

William Caxton & Co.,

   **Printers, &c.**

To

CONDITIONS.—The above Estimate includes one Proof.
Further proofs, and all author's corrections and alterations, will be
charged extra.

such as rent and insurance, in the first place. This department earns nothing, and makes no charges to customers on its own account. It collects together those of the composing room, the foundry, the pressroom, and the warehouse, and adds them together, with a percentage of profit. The ratio of expense here varies much. Two offices of similar size may exist in a city, and one may cost twice as much as the other for the counting house expenses. The most expensive one will be that in which many estimates have to be made up, and in which the orders executed are small in proportion to those of the other. In an office kept as it should be the general expenses need not go on the books of each department, but the items of each of these books are transferred from time to time and summarised and added to in the counting house.

Turn-over and Capital. It is sometimes thought that the amount of turn-over is not important provided the scale of profit is large enough. This does not apply to the printing business, in which profits are subject by competition to limitations. Supposing the printer has £5,000 invested in plant, which capital is worth to him at 4 per cent. £200 per annum. He has to allow for depreciation of plant and machinery say 10 per cent., or £500 per annum. His turn-over therefore is charged with £700 per annum before it begins to yield him a profit. If his attainable profit is 20 per cent., he will need a turn-over of £3,500 to pay these two charges. Profits begin only after these charges are met. Accordingly a turn-over of £7,000 will yield £200 interest on capital, and £700 as return for his labour. Hence turn-over in relation to capital is deserving of the most careful consideration.

Although not exactly elevated to a "custom" of the trade a uniform charge of 10 per cent. for standing matter is recognised by many houses and advocated by Master Printers' Associations.

A uniform rate of 10 per cent. seems also to be general for the purposes of depreciation of the office plant—machinery and type. One of these should perhaps be rated much higher than the other in this respect, but an all-round depreciation figure of 10 per cent.—machinery and

type alike—is found to meet the case and this is usually adopted by printers.

THE COSTING-OUT SYSTEM.

Culminating in a great Cost Congress held in London, February 18th, 1913, a movement originating in the United States became interesting to British houses, and gradually developed in favour of a uniform costing-out system for the whole of the printing trade. The method outlined and discussed at the first Congress held in London was taken up and considered in numerous centres throughout the British Isles, and everywhere the trade accepted the new doctrine with much enthusiasm, as a possible remedy for a state of affairs from which there had previously seemed no outlet.

The essentials of the system may be summed up as follows:—

To find the cost per hour of each of the processes in a printing works.

To see that the cost per hour covers all the costs—of labour, rent, rates and taxes, general expenses and use of machinery—the whole cost.

To know the cost of this basis of each job as it goes through the works. Also to be able to automatically check these costs at regular intervals.

The specified system was the outcome of the labours of a special committee of the Master Printers' Federation. The standard cost system or Westminster system, so popular in the United States, forming the basis of the scheme recommended.

The following are the chief conditions and leading features of the scheme adopted and now widely in use:—

The basis of all costs is a unit—a standard unit.

The standard unit of the production of all printing and kindred operations is the hour, or, if on piecework, the unit in typesetting, for instance, is 1,000 ems for composition.

The unit comprises the whole cost—direct departmental cost, including labour—and proportion of overhead expenses.

Costs are apportioned by charging each department with all items strictly belonging to such, and then distributing overhead expenses *pro rata*.

Except where the actual year's expenses are known to have

changed, the expenses from an average of recent years should be taken as the expenses of the year being dealt with.

A regular rate of depreciation on all plant, including type and machinery is adopted of 10 per cent. per annum on the diminishing value.

The system requires the division of the business into departments, also the ascertaining of the exact number of chargeable hours or piece units, and the value thereof in each department.

To allocate to departments all the expenses of the business. Such costs as rent, rates and taxes; light, heat and water power; various insurances; workmen's compensation; repairs and renewals; should be apportioned according to extent and equipment of each department.

Overhead expenses should include all the numerous expenses which cannot be allocated direct to any particular department—advertising, stationery, discounts, carriage, bad debts and so on. These expenses may be met by a percentage on the value of chargeable materials—10 per cent. usually—or by a percentage on departmental costs, i.e., wages plus departmental expenses.

An essential feature in the working of the system consists of gathering together the chargeable hours and piece units worked in each department, and the value thereof for the week. In order to ascertain this, chargeable and non-chargeable work must be defined and entered thus upon the dockets.

To arrive at the hourly rate for machines, as these vary in size, output and general value, each should be assessed on a system of units, which will represent the proportional cost of running, exclusive of minder's and feeder's wages.

For instance, units may be arranged thus :—

Cylinder or platen up to Crown sheet	-	2 units,
Wharfedale up to Royal sheet	-	4 „
Wharfedale up to Double Royal sheet	-	6 „
Wharfedale up to Quad Demy sheet	-	8 „
Two-revolution Quad Demy sheet	-	10 „

and, similarly, units may be worked out for all classes of printing and binding machines.

To find the value of work produced :—

In the composing department the number of chargeable hours or piece units in the week should be ascertained from the dockets. The total of the chargeable hours multiplied by the hourly or piece unit rates gives the value of production for the week.

Similarly, the machine-room dockets will give the chargeable hours of each machine, and these, multiplied by the hourly rate of the machine, will give the production of that machine for the week. Other departments are gauged accordingly.

To obtain the cost of each job, the value of work done must be transferred from the daily dockets to a Job Cost Sheet, the cost of each department being kept separately. When the job is finished all the labour costs will appear on this sheet, and to this the value of chargeable materials used, and a percentage for handling, should be added.

The total obtained represents costs and general expenses. Profit must now be added.

THE SMALL PRINTER AND THE COST KEEPING SYSTEM.

It was, however, widely felt that some simplification of the system for small businesses was desirable. The business dealt with in the forms originally circulated had ten departments, and a turn-over of nearly £50,000 per annum, and consequently more forms and accounts would be necessary than in a small business; but the system is equally suitable for a turn-over of £2,000 or £200,000 per annum. The Costing Committee then prepared the same forms, a little simplified, for a business with an annual turn-over of under £3,000 and with three departments—composing, machining and binding.

Concerning this Mr. Howard Hazell, whose services to the printing industry in assisting to lay out and explaining the Costing System are here warmly acknowledged, states that the essential parts of the system must, however, be maintained as the small business grows into the large business, and uniformity of costing methods throughout the country is necessary, if the full benefits of these improved methods are

to be obtained. If various systems are adopted, the results, and the hourly rates, owing to the different methods of dealing with the general expenses, etc., will lead to varying prices for each process, and consequent confusion and discredit will be brought upon the system. If one printer puts all his general expenses on labour only, and another on labour and material; if one includes clearing in his composition-hour and his neighbour does not, much of the benefit of the system will be lost.

The essential points are :—

- (1) The allocation of the general expenses into departmental and overhead expenses, by the methods shown in Forms 1 and 2 ;
- (2) The weekly statement of cost of production, Form 3, to show whether the hourly rates are correct ;
- (3) The collection of all chargeable hours worked on a job, which, multiplied by the various rates, gives the cost of each job, and the collection of all the chargeable hours in the week to find the value of production for the week.

The forms necessary to obtain this information in a small business are very simple. Forms 1 and 2 are made out once a year, and would probably be best filled up from the firm's yearly accounts. Form 3 is made out once a week, and also Form 4, which only needs three figures to be entered to obtain the necessary information.

A combination daily docket for all the departments gives the chargeable hours, and are the only forms used in the works. The value of production is a combination of Forms 9, 10 and 11, originally suggested for a larger business, and the job cost docket is essential to find the cost of each job and to know which are profitable and which are unprofitable.

Suggestions for an order book for the office and work ticket to accompany the job through the works, probably in use in every office, complete the forms for a small business.

Only nine forms in all, two of which are used once a year : one only contains three figures weekly, two are already in use, and the remainder give to the printer the essential information of what each job and each process has actually cost him.

Probably every printer has some form of daily docket in use, on which workpeople record the hours spent on each job, and if this is adapted to separate chargeable from non-chargeable hours (e.g., clearing, oiling-up, idle time, etc.) the extra forms are very few indeed. The daily dockets issued by the Committee are in the simplest possible form to show the chargeable and non-chargeable hours, and also the overtime. Each printer may modify these dockets to suit his own business ; but any docket, provided it gives the names of the job and the hours actually worked on it, is sufficient to fit in with the system. All additional information, such as overtime worked, hours spent on author's corrections, delays due to bad copy, or waiting for customer's instructions, will assist the printer in making a charge for the extra work which is too often overlooked unless a proper docket is in use.

The daily docket is in use in most printing houses, and the introduction of a cost-keeping system need not cause any anxiety to the workpeople. A good system transfers, as far as possible, to the office the keeping of accounts, and the writing in the works is reduced to a minimum, so that the foremen and workmen are able to give their time and attention to the skilled work for which they are engaged. But it is essential that a correct record should be kept of the actual hours worked on each job, in order that the printer may know if he is making a profit or a loss upon it. If the daily dockets are correctly kept, any error in an estimate is soon detected, and if a customer alters his instructions after the job is put in hand the extra cost is shown, and the customer can then be charged with the cost of the additional work, instead of it coming out of the pocket of the printer.

The whole aim of the cost keeping system is to enable the printer to know his costs and to charge a reasonable price for his work.

STATEMENT OF EXPENSES

Form No. A1.

Showing Standing Departmental Expenses per Annum and per week.

The following figures are hypothetical but approximately correct for the class of business shown.
The business dealt with in this example spends £1,050 per annum in Wages.

Capital invested, £2,000.
Total sales - - - £3,000.
750 " " in Materials.
675 " " in Expenses.
£2,475

ASSESSMENT OF TOTAL EXPENSES BASED ON PREVIOUS YEAR OR YEARS.		DIRECT DEPARTMENTAL EXPENSES.				TOTAL DIRECT DEPARTMENTAL EXPENSES.	OVERHEAD EXPENSES NOT DIRECTLY CHARGEABLE TO DEPTS.
		COMPOSING ROOM.	MACHINE ROOM.	BINDERS.	PAPER OR MATERIALS STOCK ROOM.		
£		£	£	£	£	£	£
130	Rent, Rates and Taxes, Light, Heat and Water (divided according to floor space)	60	40	20	10	130	—
20	Power - - - - - (divided according to amount used)	—	16	4	—	20	—
120	Depreciation at 10% - - - - - (on value of plant in each department)	60	45	15	—	120	—
10	Fire Insurance - - - - - (according to floor space and contents)	4	3	1	2	10	—
2 10	Workmen's Compensation - - - - -	1	1	0 10	—	2 10	—
20	Repairs and Renewals to Plant and Machinery -	6	12	2	—	20	—
10	Direct Departmental Sundries - - - - -	2	4 10	4	—	10 10	—
100	Interest at 5% on £2,000 - - - - -	30	22 10	7 10	15	75	25
263	All other General Expenses - - - - - (e.g., salary for Proprietor, travellers' commissions, office expenses, stationery, postages, discounts, bad debts, spoilage and general trade expenses, etc., etc.)	—	—	—	—	—	262
675	Yearly Assessment of Standing Departmental Expenses - - - - -	163	144	54	27	388	287
	Weekly Assessment of Standing Departmental Expenses, which appears in Weekly Statement of Cost of Production - - - - -	£3:2:9 £2:15:6 £1:0:9				675	
		Deduct £75 chargeable to Materials (see note below)				27	48
		EXPENSES CHARGEABLE TO MATERIALS.				£361	£239

The suggestion of the Cost Committee is that each Printer should ascertain for himself the amount chargeable to Materials for Storing, Handling, Commission, Carriage, Bad Debts, etc., but that a *minimum* of not less than 10% on the value of Materials used should be charged.
In this business the printer did not allocate overhead expenses to materials, but considered 10% was sufficient to add to materials. 10% on £750 Materials = £75, of which £27 is shown to be the actual handling expenses (see Col. 5) and deducted from Direct Departmental Expenses (Col. 6), the balance required of £48 is deducted from Overhead Expenses (Col. 7). (In a larger business the paper warehouseman's or a share of porter's wages would be placed in the materials column as a separate amount.)
For method of dealing with the above figures see Forms A2 and A3. This form should be made out once each year.

ESTIMATE OF EXPENSES

For Year under Assessment,

and Method of ascertaining Percentage on Direct Departmental Expenses plus Wages to recover Overhead Expenses.

The Printer having *ascertained* his Direct Departmental Expenses as explained by Form A1, should then *recover* his Total Overhead Expenses (i.e., £287), by a percentage on Materials, and on Direct Departmental Expenses plus Wages actually paid, as follows :—

Total Wages estimated on last year, or by taking the average of the last three years -	-	-	-	-	£1,050
Add Direct Departmental Expenses (Form A1, Col. 6)	-	-	-	-	361
Direct Departmental Cost	-	-	-	-	1,411
Add Overhead Expenses recovered on Departmental Expenses plus Wages (Form A1, Col. 7)	-	-	-	-	239
amounting to £239 = <u>17%</u> on £1,411				(*)	£1,650
Materials	-	-	-	-	£750
Add 10% thereon	-	-	-	-	75
					825
					£2,475

(*) Rates for each chargeable hour (i.e., actual hours spent on jobs) must be ascertained to recover this amount. Some hourly rates are in use in every office. These should be continued (or new rates fixed as explained) until they are shown to be incorrect by Statement of Cost of Production Form, A3, and Departmental Analysis, A4.

This form should be made out once each year.

STATEMENT OF COST OF PRODUCTION

Form No. A3.

376

For week ending November 22nd, 1912.

Chargeable Materials (i.e., Ink, Paper, etc.) are omitted.

	COMPOSING.			MACHINE.			BINDERS.		
	£	s.	d.	£	s.	d.	£	s.	d.
Wages actually paid and Insurance Act -	10	5	0	7	6	0	2	13	0
Add Departmental Expenses - - - (as assessed, see Form A1)	3	2	9	2	15	6	1	0	9
Direct Departmental Cost - - - (without Overhead Expenses)	13	7	9	10	1	6	3	13	9
Add Proportion of Overhead Expenses - i.e., 17% on Direct Departmental Cost. (See Form A2)	2	5	3	1	14	6	0	12	3
Total Departmental Cost for the week	15	13	0	11	16	0	4	6	0
Value of Production in each Department - (at hourly or piece unit rates or at a percentage on wages obtained from Value of Production Form, A6.)	13	13	0	12	1	6	4	18	6

MODERN PRINTING.

This form should be bound as a book, and filled up weekly.

DEPARTMENTAL ANALYSIS.

Form No. A4.

WEEK ENDING.	COMPOSING.				MACHINE.				BINDERS.														
	Surplus.		Deficit.		Surplus.		Deficit.		Surplus.		Deficit.												
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.											
October 4th	-	-	-	£	0	17	6	£	0	9	6	£	0	8	0	£	0	12	0	0	10	3	
" 11th	-	-	-		1	4	0		1	12	0		0	12	0		0	12	0		0	10	3
" 18th	-	-	-		1	9	0						2	0	0						0	10	3
" 25th	-	-	-		1	15	0						0	10	0						0	14	0
November 1st	-	-	-		0	15	0						1	10	0						0	15	0
" 8th	-	-	-		2	0	0						0	12	0						0	10	0
" 15th	-	-	-		1	10	0														0	12	6
" 22nd	-	-	-		2	0	0						0	5	6						0	12	6
" 29th	-	-	-																				
December 6th	-	-	-																				
" 13th	-	-	-																				
" 20th	-	-	-																				
" 27th	-	-	-																				

This form should be kept in a book and filled up weekly. It shows the difference between the Total Departmental Cost and the Value of Production on Form A3.

This form shows that in this particular business the hourly rates in the machine and binding departments were correct, but the composing rate was too low, as there was a continuous deficit.

ESTIMATING.

DAILY DOCKET.



Employee's Name *Davidson* No. *1* Date *21/11/12*

Job No.	Customer's Name	Kind of Work done.	Machine Number.	Hours Composing.		Hours on Machine.	Ink.	Hours on Binding.
				Comp.	Author's Corr.			
233	Michael	Circ. Co.		1				
237	Stains & Son	Hpp List M.			1			
238	Thomas	Poster M R.	2			1/2	S	
		R.				1	1/3	
234	Colston & Co	Ledger M R	2			1		
		R.				1	3	
340	Wash & Jones	Circ. Co		2				
230	Hulcott	Price List M.			1 1/2			
TOTAL CHARGEABLE				3	2 1/2	3 1/2		
Non-Chargeable: State whether Reading, Proof-pulling, Distribution, Clearing, Oiling Machines, Waiting for Work, etc. <i>Ordering up</i> <i>Clearing</i> TOTAL NON-CHARGEABLE						1/2		
				1 1/2				
				1 1/2		1/2		

KINDS OF WORK:—

C.=Composing, First proof, and Imposing.
A.C.=Author's Corrections.

M.R.=Make Ready.
R.=Running on.

F.=Folding.
S.=Sewing.
Ct.=Cutting.
B.=Binding.
etc., etc.

This form must be filled up daily by each worker whose time is chargeable and the number of hours worked on each Job must be entered daily on the Job Cost Sheets Form, A7; and the total number of chargeable hours on the Value of Production Form, A6.

This form is a combination docket and can be used by a worker in any of the three departments, and also if he works in more than one.

This form should be adapted in size, shape and details, to suit each business. It may be more convenient to have a different docket with varying details for each department.

Form No. A 6.

FOR ALL DEPARTMENTS for week ending *November 22nd 1912.*

This form should be kept in a book and filled up from the Daily Dockets, A5. The total for the week of each department should be transferred to the Statement of Cost of Production Form, A3. If additional columns are needed, the form can be printed oblong or separate forms kept for each department.

In this business time workers were reckoned as follows:—Women on hand work at 6d. per hour, on wiring machines at 9d. per hour; men on hand work at 1/- per hour, on cutting machines at 1/6 per hour; and 100% was added to piece work wages.

This form should be kept in a book and filled up from the Daily Dockets, A5. The total for the week of each department should be transferred to the Statement of Cost of Production Form, A3. If additional columns are needed, the form can be printed oblong or separate forms kept for each department.

In this business time workers were reckoned as follows:—Women on hand work at 6d. per hour, on wiring machines at 9d. per hour; men on hand work at 1/- per hour, on cutting machines at 1/6 per hour; and 100% was added to piece work wages.

JOB COST SHEET.

Form No. A 7.

Customer's Name *Green & Co*
 Description *10,000 Balance Sheets*

Job No. *415.*

COMPOSING COSTS.						BINDING COSTS.								
Date.	Hours.		£	s.	d.	Date.	Hours.				Date.	Piece Wages Paid.		
	Comp.	Author's Corr.					@ 8d.	@ 9d.	@ 1/-	@ 1/6d		£	s.	d.
10/11/12	10					16/11/12	3		1	1/2	16/11/12		2	0
11 "		2				17 "	3		1/2	1/2	17 "		2	6
13 "		1					1						2	0
14 "		1					7		1 1/2	1			6	6
	10	4									100%		6	6
	4										7 @ 6d		3	6
	14		1	1	0						1 1/2 @ 1/-		1	6
											1 @ 1/6		1	6
													19	6
(Hours reckoned at 1/6 This rate is shown to be incorrect by form A4)														

MACHINE-ROOM COSTS.						PAPER OR MATERIALS.					
Date	Mach No.	Hours.	£	s.	d.	Date.	Particulars.	@	£	s.	d.
15/11/12	3	1				15/11/12	10 Rms 12 Drs.				
16	"	12					C.L. 20 Cap	4/-	2	2	6
(Machine No 3 is rated at 2/6 hr)		13	1	12	6		15%			6	4
		15%		1	4				2	8	10
Ink					2						
			1	14	0						

OUTDOOR COSTS.						SUMMARY.							
Date	Order No.	GOODS.	@	£	s.	d.							
14/11/12	2593	10,000					Composing	...	...	...	1	1	0
		Envelopes	6/-	3	"	"	Machine	...	...	...	1	14	0
			10%		6	"	Binding	...	...	...		19	6
				3	6	"	Paper or Materials	...	...	...	2	8	10
							Outdoor Costs	...	...	...	3	6	0
							Total Cost	..	..	..	9	9	4
							Add for net profit	%	...	...	1	11	8
							Total Charge	..	..	..	11	1	0

In this particular business the hourly rates in the binding room were:—Women, 6d.; men, 1/-, and men on cutting machines, 1/6 per hour. The number of columns and rates must be adjusted to each business.

This form should be kept in the office in some form of loose leaf binder, and the costs entered on it daily from the Daily Dockets. When the job is finished, this sheet should be attached to and filed away with the Work Ticket, A9. For very large jobs extra sheets suitably printed for each department can be added behind this form, on which the costs are collected.

ORDER BOOK.

Date.	Work Ticket No.	Customer's Name (and their Order Number).	Description of Job.	Day Book Folio.
1912				
Nov 7	410	John Smith	1,000 Billheads	27
" 7	411	Adams	500 Envelopes. ftd.	27
" 8	412	Carson & Co	8 pp Price List.	
" 8	413	Moate & Co	2 Day Books.	
" 10	414	Geoffrey Carr	100 Visiting Cards.	27
" 10	415	Green & Co	10,000 Balance Sheets.	29
" 11	416	Burn & Brown	Proof 4 pp Circ.	
" 11	417	Henderson	Poster	

WORK TICKET or ORDER SHEET.

Form A 9.

Work Ticket No. 415.Date Nov 10th 1912Customer Green & CoDay Book Folio 29Address Walton Road, London, S.E.Customer's Order No. 1879Estimate No. 278

	QUANTITY.	DESCRIPTION.	SIZE.
Show 3 Proofs.	10,000	Balance Sheets.	L. Fol. 4 ^{to} fly.
		L. Primer, printed Black, Folded to endorse & inserted in envelope stuck down.	
Nov 11	Revise		
" 13	"		
" 14	Press		
		Deliver 2,500 Nov 14 th to Green & Co	
		Balance Nov 18 th to The Addressing Agency, High Street, E.C.	
	Delivery wanted by		

DATES RECEIVED BY EACH DEPARTMENT.

COMPOSING	MACHINE	BINDING	PAPER
<u>Nov 10th</u>	<u>15/11/12</u>	<u>Nov 14th</u>	<u>15/11/12.</u>

DELIVERIES.

Date.	Quantity.	Delivery Note No.	Date.	Quantity.	Delivery Note No.
<u>Nov 7th</u>	<u>2,500</u>	<u>2709</u>			
<u>" 18</u>	<u>7,500</u>	<u>2723</u>			
	<u>10,000</u>				

This Work Ticket may be printed as a single form or as an envelope. The envelope is convenient for holding copy, patterns, etc., and should accompany the job through the works. The particulars should be sufficient for the work to be carried out without further instructions.

MACHINE UNITS.

Form No. 13.

Example showing how to find the hourly rate of each machine.

The value of ink used is not included, and must be added to the hourly rate to find the cost of each job.

1	2.	3.	4.	5.	£ s. d.	6.	7.	8.	9.	10.	11	12.	13.
Machine	Original Cost of Machine.	No. of Units for each Machine. Estimate 1 unit for every £50.	Average hours Machine is in use in the week	Total hour Units per week (Col. 3 x Col. 4)	Average weekly Total Cost of Dept. ... Less Chargeable Wages (Total of Cols. 7 + 8)	Machine Unit Hour Cost (Hourly unit value, i.e. 2.55 " by Col. 3).	Feeder's Wages.	Minder's and Apprentice's Wages.	Minder's Wages, if no Apprentice.	Minder's Wages, with adjustment to include Apprentice.	Total Weekly Wages paid on each Machine after Adjustment.	Wages per chargeable hour.	Machine hourly rate = Wages + Machine unit hour Cost
2 D Muhle	£ 550	11	46	440	14.0.0	2/4	12/6	45/-	45/-	37/6	50/-	1/3	3/4
2. Gr Wharfe	325	7	37	259	Divide this amount by the total of Col 5, and this will give Hourly Unit Value = 2.55 ^d	1/6	10/-	37/6	37/6	31/6	40/6	1 1/4	2/7 1/4
"	325	7	37	259		1/6	10/-	35/6	35/6	29/6	40/6	1 1/4	2/7 1/4
Royal	225	5	40	200		1/1	7/6	35/6	35/6	29/6	22/3	6 3/4	1/4 3/4
Denny	200	4	40	160		10 1/4	7/6				22/3	6 3/4	1/5
				1318			£ 2.7.6	6.8.0	7.13.6				
							£ 8.15.6						

In Col. 10 the minder's wages have been adjusted, so that the advantage of lower wages paid to apprentices is not taken by any one machine or customer. The advantage is spread over the whole room. The chargeable hours of each machine at the hourly rates in Col. 13 should be entered on the Job Cost Sheets and the Value of Production Form.

This form should be made out and the hourly rates continued for a year. The rates can then be checked again.
Every machine in the department should be included in this form.

INDEX.

	PAGE.		PAGE.
Acme Platen Machine ...	28	Beard of Types ...	287
Adaptability of Paper ...	260	Bearers of Wharfedale Machine ...	49
Adjustment of Platen of Machine ...	23	Bearers on Hand Presses ...	15
Aim of Cost Keeping System	373	Bearers, Treatment of, in Cylinder Machine Work	66
Albion Press ...	2	Bed of the Press ...	2
Algraphy... ..	284	Bed of Wharfedale Machine	43
Allowance, Proportionate, for Depreciation of Plant	370	Benzoline for Washing	
Alloying Type Metal ...	288	Formes ...	181
All-size Rotaries ...	166	Bituminous Gas Plant ...	324
Aluminium Inks ...	251	Black, Combinations of	
Aniline Colours ...	204	Colours with ...	192, 194
Annand Double Roll Machine	156	Black Ink ...	183
Annand Folding Apparatus	157	Blanketing for Hand Press	13
Annand Single-Roll Machine	156	Blocks, Justification of, in	
Annand Three-Roll Machine	158	Formes ...	72
Annand Web Machines ...	155	Blocks, Overlaying ...	75
Anti-friction Rollers of Wharfedale Machine ...	44	Blocks, Photo Process ...	294
Apportioning Costs ...	369	Blocks, Printing, in Colours	211
Apprentices ...	331	Blue, Harmonies with ...	190, 193
Aquatints ...	277	Blue Ink, Use of ...	201
Arrangements for Attaching to Folding Machines ...	316	Bookbinders' Cloth for	
Art Caxton Platen Machine	24	Ground Tints ...	218
Art Paper ...	259, 261	Bookwork on Wharfedale Machine ...	60
Art Rotaries ...	165	Borders for Ground Tints ...	217
Automatic Delivery at Platen Machines ...	30	Borders, Working, on Cylinder Machines ...	62
Automatic Feeders ...	110	Bowls of Wharfedale Machine	44
		Brasses of Wharfedale Machine ...	49
Baggy Tympan at Platen Machines ...	38	Brayer Ink Table ...	10
Baker's Embossing Method	242	Bremner Foolscap Rapid ...	95
Baker's Stencil Tinting Process ...	223	Bremner Stop-Cylinder Machine ...	92
Baker's White Letter Etching Process ...	225	Bronze Preparation ...	245
Bank and Horse ...	9	Bronze Printing ...	245
Bar of the Hand Press ...	4	Bronze Printing, Conditions governing ..	235
Beard of a Cylinder Machine	59	Bronzing Machines ...	232
Beard of Wharfedale Cylinder	45	Bronzing, Method of Hand	247
		Brown Ink, Use of ...	202

INDEX.

	PAGE.		PAGE.
Building in Electrotyping ...	270	Colour Printing ...	186
Buying Machines ...	302	Colour Printing, Composing	
Buying Paper ...	259	for ...	205
Calico for Wharfedale		Colour Rotaries ...	166
Cylinders ...	61	Colour Scale, The ...	187
Capital and Turnover ...	368	Colours, Classes of ...	187
Cardboard for Ground Tints	217	Colour Screens in Photo-	
Cardboard Method of		Chromotype Printing ...	228
Embossing ...	240	Colours for Ground Tints ...	219
Card Overlaying ...	82	Colours, Modification of by	
Cards, for Colour Printing...	197	Proximity ...	196, 203
Card System ...	306, 307	Colours on Coloured Surface	197
Care of Machines..	299	Colours, Order of... ..	208
Carriage of Hand Press ...	3	Colours, Succession of ...	212
Carriage of Wharfedale		Colours under Gold ...	247
Machine ...	43	Colour Work, Consecutive	
Casting Rollers ...	167, 171	Operations of ...	207
Casting Type..	286, 288	Columbian Press ...	2
Casual or Temporary		Columbian Press Levers ...	6
Employment ...	353	Combinations of Colours	
Catalogues, Justifying Pages		with Black ...	192, 194
of ...	73	Combinations of Hues... ..	191
Celluloid Counterparts in		Combinations of three or	
Embossing ...	243	more Colours ...	192
Centring the Forme at Hand		Combinations of Tones ...	191
Press ...	13	Combinations of two Colours	189
Changing Formes at Machine	301	Common Press Points... ..	17
Chapel Rules ...	329	Companionships ...	328
Chargeable Work ...	370	Complementary Colours,	
Characteristics of good		Definition of ...	187
Machine Work ...	70	Composition Melting Kettle	170
Checking of Cylinder of		'Compositors' Wages ...	356
Wharfedale Machine ..	50	Conditions Governing	
Chemical Ground Tints ...	217	Bronze Printing ...	235
Chill of a Hand Press...	5	Copperplate Engraving ...	276
Chromo-Lithography ...	281	Copyable Printing Inks ...	185
Chromotypy ...	227	Cossar Flat-bed Web Press	162
City and Guilds Institute		Cost, Comparative, of	
Examinations ...	337	Lighting ...	321
City and Guilds Institute		Cost, Comparative, of Power	324
Syllabus ...	340	Costing Out System ..	369
Classification of Rotary		Cost Keeping System, Aim	
Web Printing Machines	143	of... ..	373
Cleaning Machines ...	300	Cost Keeping System and	
Cleanliness in Colour Printing	204	the Small Printer ...	371
Clickers' Duties ...	328	Cost Keeping System,	
Closed Days ...	351	Essential Points of... ..	372
Coal-tar Colours ...	204	Cost Keeping System,	
Coated Papers, Printing upon	69	Forms for ...	374-383
Coffin of the Press ...	2	Costs, Apportioning ...	369
Cold Colours, Definition of	187	Counterparts suitable for	
Collating... ..	314, 315	Embossing ...	243
Collotype ...	282	Counting House ...	366
Coloured Inks, Hints on use of	198	Counting Work from	
Coloured Papers and Cards	197	Machine ...	310
		Covering a Frisket ...	18

INDEX.

	PAGE.		PAGE.
Covering a Tympan	7	Distributing Ink for Hand	
Crank Shaft of Wharfedale		Press	3
Machine	43	Distributing Power, Insuffi-	
Creasing at Platen Machines	39	cient, on Cylinder Machines	63
Creasing in Cylinder Machine		Distribution, Cylindrical	
Work	67	System	87
Cropper Hand	21	Distributors, Fraying of ...	178
Cropper Platen Machine ...	20	Distributors of Wharfedale	
Cross Feeder... ..	111	Machines	47
Crown of Wharfedale Cylin-		Division of Businesses into	
der	45	Departments	370
Cuts, Making Ready	75	Dockets, Time, Utility of ...	371
Cutting Estimates	359	Doubletone Inks	185
Cutting out a Frisket	9	Drawing for Line Process... ..	297
Cutting the Punch for Type	286	Draws in Cylinder Machine	
Cylinder Bearings of Wharfe-		Work	64
dale Machines	48	Dressing Cylinder of a Two-	
Cylinder Brasses of Wharfe-		Revolution Machine	107
dale Machine	49	Dressing the Cylinder of a	
Cylinder Machines, Points of		Wharfedale Machine	58
excellence in	49	Dressing Type	288
Cylinder Movement of		Driving Shaft of Wharfedale	
Wharfedale Machine	44	Machine	43
Cylinder of Machine,		Drop-bar Feeders on Folding	
Adjusting	301	Machines	318
Cylinder Principle of Impres-		Drop-bar Feeding of Perfect-	
sion	41	ing Machine	125
Cylinders of Rotaries	165	Drum Cylinder Press	90
Cylindrical Ink Table	11	Drying Box in Stereotyping	267
Cylindrical System of Dis-		Drying Printed Matter	309, 315
tribution	87	Drying Racks	309
		Dry Process of Stereotyping	268
Daily Dockets	373	Duct Knife of Wharfedale	
Damped Sheets on Wharfe-		Machine	46
dale Cylinder	60	Duct of Platen Machine	21
Damping Board for Wharfe-		Duct of Wharfedale Machine	46
dale Work... ..	61	Ductor, Adjustment of	66
Dark Tones of Colour	187	Duplex Flat-bed Web	
Dawson's Fast Gripper Per-		Machine	161
fecting Machine	120	Duplex Papers	257, 259
Deckle Edged Paper	255	Dutch Metal Printing	250
Definition of Printing	1	Dux Feeder	113
Delivery, Automatic, at			
Platen Machines	30	Earhart, (J. F.), on Colour	
Delivery on Art Rotaries ...	166	Printing	188
Departments, Division of		Earhart, (J. F.), on Ground	
Businesses into	370	Tints	221
Depreciation of Plant,		Earhart, (J. F.), the "Har-	
Allowance for	370	monizer"	197
Designing Face of Types ...	285	Earhart, Mr., on Rollers ...	168
Disc, Ink, of Platen Machine	21	Edler, A., & Co., Kohlbach	
Dissecting a Forme for		Bronzing Machine	234
Colour Work	206	Elbow Points... ..	17
Distinguishing Hand and		Electric Light in the Printing	
Machine-Made Paper	257	Office	321
		Electric Motors	324

INDEX.

	PAGE.		PAGE.
Electrotyped Matrices in		Finding Value of Work	
Type Founding	287	produced	371
Electrotypes, Storage of ...	273	Finishing Type	288
Electrotyping... ..	270	Flat-bed Web Machines ...	161
Electrotyping, Slow and		Flat of Wharfedale Cylinder	44
Quick Process	271	Flong, in Stereotyping	267, 268
Elliott and Defiance		Flyers, Improved, of Wharfe-	
Cylinder Machines ...	93	dale Machine	52
Embossing by Letterpress		Flyers of Wharfedale Machine	45
Processes	238	Folding Machines	316
Embossing Plate, fixing the	242	Folding Machines, Arrange-	
Enamelled Papers, Printing		ments for attaching to ...	316
upon	69	Folding Machines, Drop-bar	
Endurance of Paper	263	Feeders on	318
Engine-Sized Paper	258	Folding Machines, Principal	
Equivalent Weights of Paper	263	Points in	317
Esparto in Paper Making ...	253	Folding on Periodicals ...	312
Essential Points of Cost		Folding on Web Machines	138, 145
Keeping System	372	Folding, Operation of ...	310
Establishment Expenses in		Forks of Wharfedale Machine	47
Printing	363, 365	Forme, Position of, on Hand	
Estimate Form	367	Press	11
Estimate Preparing, General		Formes, Preparing for	
Notes on	363	Electrotyping	272
Estimates, Cutting	359	Formes, Washing... ..	180
Estimating	359	Forme Table of Hand Press	3
Estimating for Bronze Work	250	Form for Estimate	367
Etchings	277	Forms for Cost Keeping	
Examinations of the City and		System	374-383
Guilds Institute	337	Foundations of Machines	47, 300
Examinations, Scope of,		Framework of Wharfedale	
C. & G. Institute	339	Machines	48
Expenses of a Printing		Franklin Press	20
Business	363	Fraying of Distributors ...	178
Expenses, Overhead	370	Fraying on Cylinder Machine	
Express Falcon Platen		Rollers	51
Machine	31	Friars in Cylinder Machine	
Eyesight of Compositors ...	322	Work	63
		Friars in Hand Presswork...	4
Face, Designing, in Type		Frisket, Covering	18
Founding... ..	285	Frisket Fingers on Platen	
Falcon Safety Platen Machine	30	Machines	39
Feed Board of Wharfedale		Frisket of a Hand Press ...	8
Machine	45	Fudging Device on Rotary	
Feeders, Automatic	110	Web Printing Machines	153
Feeders, Wages of	355	Full Colours	187
Feed Gauges of Platen			
Machines	35	Gas Engines	323
Feeder Inking Roller of		Gate of Wharfedale Flyers	45
Wharfedale Machine ...	47	Gathering	314
Feeding a Platen Machine...	37	Geared Rollers of Wharfedale	
Feeding arrangements of		Machine	50
Perfecting Machines ...	124	Gelatine and Glycerine	
Feeding arrangements of		Rollers	168
Platen Machines	21	General Notes on Estimate	
		Preparing	363

INDEX.

	PAGE.		PAGE.
General Store, Management		Harwood, Mr. J. H., on Con-	
and Utility of	305	trasts of Colours	196
Glue, Properties of	168	Harwood, Mr. J. H., on Print-	
Glycerine and Glue Rollers	168	ing Blocks in Colours ..	211
Glycerine, Properties of ...	169	Hazell, Mr. H., and the Cost	
Gold Inks	251	System	371
Gold Leaf Printing	250	Heliotypy	227
Gold on Ground Tints... ..	219	Hellman Flat-bed Web	
Gold Preparation... ..	245	Machine	162
Gold Printing... ..	245	Heureka Flat-bed Offset	
Gordon Platen Machine ...	20	Newspaper Press	165
Graduated Tint	220	Hints for Photo Process	
Grain, in Tone Blocks... ..	296	Block making	297
Graphic Arts Auxiliary to		Hoe Perfecting Press	127
Letterpress Printing ...	274	Hoe Rotary Web Machine	139
Grayson, Mr. R., on Bronze		Hoe Stop-Cylinder Press ...	88
Printing	249	Hoe Two-Revolution	
Grayson, Mr. R., on		Machine	100
Embossing	238	Hours, Chargeable and	
Grayson, Mr. R., on the		Non-chargeable	370
Graduated Tint	220	Hue, Definition of... ..	187
Green, Harmonies with 190, 193		Hues, Combinations of... ..	191
Green Ink, Use of... ..	202	Hurried Drying of Printed	
Green Rollers	177	Matter	315
Grey, Combinations with ...	195	Illustrated Formes, Locking up	72
Grey, Harmonies with	192	Illustrated Work on Wharfe-	
Gripper Fed Platen Machine	27	dale Machine	60
Gripper Feeding of Perfect-		Impression Bearers of	
ing Machines	124	Wharfedale Machine ...	49
Grippers, Adjustment of ...	301	Impression on Platen	
Grippers of Wharfedale		Machines, Regulation of	22
Machine	45	Improved Franklin Platen	
Grippers of Wharfedale		Machine	23
Machine, Treatment of... ..	49	Improvements in the Wharfe-	
Ground Tints... ..	216	dale Machine	52
		Indentures of Apprenticeship	332
Haddon Safety Platen		Independent Driving of	
Machine	27	Machines	325
Half-Tone Blocks... ..	295	India-rubber Counterparts	
Half-Tone Blocks, Machines		in Embossing	243
for	85	Indigo Ink, Use of	202
Half-Tone Blocks, Preserving	85	Ink, Copyable	185
Half-Tone Colour, Definition		Inkers of Wharfedale Machine	47
of... ..	187	Ink for Damped Paper ...	184
Hamm Flat-bed Web Press	162	Ink for Fast Machines... ..	184
Hand and Machine-Made		Ink for Platen Machines ...	184
Paper, Distinguishing ...	257	Ink for Poster Work	184
Hand Bronzing, Method of	247	Ink for Super - Calendered	
Hand Press	1	Paper	184
Hand Press, Working of ...	11	Inking arrangements of	
Hand Presswork	2	Cylinder Machines	43
Hand-Made Paper 255, 257, 260		Inking Arrangements of	
Hard Packing for Platen		Perfecting Machines ...	124
Presses	39	Inking arrangements of	
Hard Paper	261	Wharfedale Machines ...	46

INDEX.

	PAGE.		PAGE.
Inking arrangements of		Lighting, Comparative Cost	
Platen Machines	21	of	321
Inking at Hand Press	3	Lighting of the Printing	
Inking on Art Rotaries	165	Office	319
Ink, Printing	183	Light Tones of Colour	187
Ink, Qualities of	184	Line Blocks, Making Ready	74
Inks, Coloured, Properties of	200	Line Process Blocks	295
Inks for Colour Printing	198	Linseed Oil in Ink... ..	183
Inks for Different Classes of		Liquid Overlaying	82
Work	184	Lithography	278
Inks for Photo-Chromotypy	230	Loading in Paper	261
Ink Slice for Hand Press	10	Locking-up Chases for Hand	
Inks, Stiff, Working	178	Presses	13
Ink Supply of Cylinder		Locking-up Illustrated Formes	72
Machines	87	Loft-Dried Papers	256
Ink Table of Hand Press	10	London Wages	348
Ink Table of Wharfedale		Lye	180
Machine	51		
Ink, Testing of	183	Machine Compositors'	
Inside Reams, Contents of... ..	259	Wages	351
Interleaving Machine	95	Machine Cylinders, Adjusting	301
Ireland, Wages in	358	Machine Finish in Paper	258
Izal for Washing Formes	181	Machine Foundations	47, 300
		Machine-made Papers	259
Jet of Type	289	Machine Managers	352
Job Cost Sheet	371	Machine Minders	48
Justifying the Matrix in Type		Machine (Printing) Wages	352
Founding	287	Machine Room, Cleanliness in	299
Juxtaposition of Colours	203	Machine Room operations	48
		Machines, Care and	
Kampe's Tint Block Process	223	Purchase of	299
Keeping Rollers in Condition	175	Machines, Cleaning	300
Kelly, Mr. W. J., on Platen		Machines, Oiling	301
Presswork... ..	39	Machine Springs	302
Kelly Perfecter Machine	120	Machines, Reversing	
Kerning Type	289	Motion of	301
Key Block, Proving the	211	Machines, Testing	300
Koenig & Bauer Stop Press	95	Machine, Technical use of	
Koenig & Bauer Two-		the term	1
Revolution Press	104	Machine Work, Characteris-	
Koh-i-Noor Platen Job Press	32	tics of good	70
Kohlbach Bronzing Machine	234	Magneto Electric Machine	
		for Electrotyping	271
Labourers in Machine Rooms	48	Make-ready for Platen	
Labour-Saving Tint Blocks	222	Presses	39
Laid Paper	258	Making Ready at Hand Press	14
Lampblack in Ink	183	Making Ready Blocks	74
Layers-on in Machine Rooms	48	Making Ready for Bronze	
Layers on, Wages of	355	Printing	246
Laying-on Board of Wharfe-		Making Ready for Woodcuts	76
dale Machine	45	Making Ready on a Two-	
Lays of Wharfedale Machine	45	Revolution Machine	108
Lead for Ground Tints	217	Making Ready on Wharfe-	
Leads, How Cast	293	dale Machines	57
Lifters for Distributors of		Making Ready Process	
Wharfedale Machines	52	Blocks	77

INDEX.

	PAGE.		PAGE.
Making Ready Type Formes		Oiling Machines	301
at Platen Machines ...	34	Oleography	284
Mann, G., & Co., Bronzing		Operations in Warehouse ...	310
Machines	235	Optimus Two-Revolution	
Marinoni Perfecting Machine	120	Press	104
Matrices, Electrotyped ...	287	Orange, Harmonies with	190, 193
Matrix in Stereotyping ...	266	Order of Colours	208
Matrix Justifying, in Type		Outside Reams	260
Founding	287	Overhead Expenses	370
Matrix Striking, in Type		Overlays for Blocks	212
Founding	287	Overlays for Blocks, Cutting	80
Meal Times	351	Overlays, The Painting	
Mechanical Bearers for Hand		Method	82
Presses	16	Overlaying at Hand Press...	15
Mechanically-made Overlays	83	Overlaying, Theory of ...	76
Mechanical Matrix Cutting	290	Overtime, Payment for ...	348
Melting Kettle for Roller			
Composition	170	Packing for Platen Presses	39
Metal Furniture, How Cast	293	Packing of a Wharfedale	
Metal Leaf Printing	250	Machine	58
Metal Plates for Ground		Packing of Hand Press	
Tints	216	Tympan	3
Mezzotint Plates	277	Packing the Platen of a	
Middleton Perfecting		Machine	34
Machine	120	Packing the Tympan of Hand	
Miehle Press	101	Press	13
Mill Finish in Paper	258	Pamphlets, Justifying Pages	
Mill Reams, Contents of ...	259	of	73
Minerva Platen Machine ...	20	Paper, Adaptability of ...	260
Modification of Colours by		Paper, Art	259, 261
Proximity	196, 203	Paper, Buying	259
Monks in Cylinder Machine		Paper, Deckle Edged	255
Work	51	Paper, Endurance of	263
Monks in Hand Presswork...	4	Paper, Engine-Sized	258
Motors	325	Paper, Equivalent Weights of	263
Moulding, in Electrotyping	271	Paper for Bronze Printing ...	247
Mould in Stereotyping ...	266	Paper for Colour Printing ...	197
Moulds, Roller ... 171, 172,	173	Paper for Photo-Chromotypy	230
Mounts, Height of	78	Paper for Process Blocks ...	84
Movable Type Formes on		Paper, Hand-Made	255
Wharfedale Machines ...	57	Paper, Hand-Made, Ream of	
Multi-Colour Machines ...	116	257, 260	
Multiple Web Machines ...	139	Paper, Hard	261
Multipress Flat-bed Web		Paper Incoming Stock Book	306
Machine	162	Paper, Laid	258
News Compositors' Wages	347	Paper, Loading in	261
News Reams, Contents of ...	259	Paper, Loft Dried... ..	256
Newsum Dust-proof		Paper Making by Hand ...	255
Bronzing Machine	235	Paper, Manufacture of ...	252
News Work	350	Paper, Machine or Mill Finish	258
Non-chargeable Work ...	370	Paper, Plate-glazed	258
Non-unionist Wages	358	Paper Pulp or Stuff	252
Off-set in Hand Presswork...	19	Paper, Qualities of	260
Oil Engines	323	Paper, Raw Materials of ...	252
		Paper Required for a Job ...	263

INDEX.

	PAGE.		PAGE.
Paper, Right and Wrong		Points, Perfecting a Sheet	
Side of	257	without	66
Paper, Rolled... ..	258	Pointing Apparatus of	
Paper, Soft	261	Wharfedale Machine ...	47
Paper Stock Book	306	Pointing at Hand Press ...	16
Paper, Strength of	262	Pointing on Wharfedale	
Paper, Super-Calendered		Machines	47
	255, 262	Poster Work on Wharfedale	
Paper, the Ream of	260	Machines	60
Paper, Tub-Sized	258	Pour, the, in Stereo Plates...	267
Paper, Varieties of	257	Power	323
Paper, Wove	258	Power, Comparative Cost of	324
Papers, Duplex	257, 259	Power in Hand Presses ...	4
Papers, Retree	259	Preparing Formes for	
Paragon Press Platen		Electrotyping... ..	272
Machine	29	Preserving Half-Tone Blocks	85
Parchments for Hand Press		Press and Machine contrasted	2
Tympan	7	Pressing of Printed Matter	314
Paste Points	17	Pressmen's Wages	355
Patching in Hand Presswork	15	Press Points	17
Patching-up on the Cylinder	62	Press, The	1
Patent Gauges for Platen		Pressure Gas... ..	324
Machines	36	Pressure, Varying, at Hand	
Payne Interleaving Machine	95	Press	14
Payne Special Wharfedale	94	Presswork	11
Pencil Drawings for Block		Preventing Set-off on	
Making	298	Perfecting Machines ...	124
Perceler Press	93	Primary Colours	187
Perfecting a Sheet without		Principal Points in Folding	
Points	66	Machines	317
Perfecting Machines	119	Printed Paper Account ...	307
Perfect Reams, Contents of	259	Printed Paper Warehouse ...	315
Petroleum for Washing		Printers' Chapel	329
Formes	181	Printing Blocks in Colours	211
Phoenix Platen Machine ...	30	Printing, Definition of ...	1
Photo-Chromotypy	227	Printing Ink	183
Photo Engraving, Process of	294	Printing Machine Managers	352
Photogravure	278	Prismatic Colours, Defini-	
Photo-lithography	283	tion of	188
Photo Process Blocks... ..	294	Process Block Making ...	294
Photo-Trichromatic Printing	227	Process Blocks, Making	
Picks at Hand Presswork ...	19	Ready	177
Piece Wages	348	Process Blocks, Paper for ...	84
Pigments used in Coloured		Process Blocks, Working ...	82
Inks	200	Producer Gas	324
Plate-glazed Paper	258	Properties of Inks used in	
Platen Machines	20	Colour Printing	200
Platen Machines, Difficulties		Protectors for Feeders at	
in Working	38	Platen Machines	29
Platen Machines, Feeding ...	37	Provincial Rates of Wages	357
Platen Machines, Working of	34	Proving the Key Block ...	211
Platen of a Press	2	Proximity of Colours, Modi-	
Platen Screws	23	fication by	196, 203
Point Screw	17	Pull in Hand Presswork ...	6
Points of Advantage in Web		Punch Cutting, in Type	
Machines	135	Founding	286

INDEX.

	PAGE.		PAGE.
Purchase of Machines...	299, 302	Rollers, Washing ...	179
Purple, Harmonies with	190, 193	Rolling at Hand Press ...	3
Putting on the Tympan Sheet	13	Rolling Power, Insufficient, on Cylinder Machines ...	63
Quadrats, How Cast ...	293	Rotary Web Printing Machines ...	133
Quadruple Presses ...	139	Rotary Web Printing Machines, Unit Principle	140
Qualities of Ink ...	184	Rule Borders, Working, on Cylinder Machines ...	62
Qualities of Paper ...	260	Runners of Wharfedale Machine ...	44
Qualities of Rollers ...	167, 174	Rust Press ...	2
Quarto Circular in Colours, Method of Working ...	208	Safety Vacuum Bronzer ...	232
Quotations, How Cast...	293	Sagging at Wharfedale Machine ...	50
Rack Wheels of Wharfedale Machine ...	43	Sagging of Sheet in Cylinder Machine Work...	65
Rags in Paper Making ...	252	Schmier's Bronzing Machine	235
Rails of Wharfedale Machine	44	Scope of Examinations, C. & G. Institute ...	339
Ream of Paper ...	259	Scotland, Wages in ...	356
Recipes for Roller Composi- tion ...	170	Sealing-Wax Counterparts in Embossing ...	243
Reciprocating Motion in Cylinder Machines ...	42	Seasoning of Rollers ...	174
Red, Harmonies with ...	189, 192	Secondary Colours ...	187
Reductions in Process Work	297	Set-off, Preventing, on Perfecting Machines ...	124
Reference Sheet in Overlay Work ...	80	Set-off on Art Rotaries ...	165
Register at Hand Press ...	16	Setting Grippers of Wharfe- dale Machine ...	49
Register, Imperfect, on Cylinder Machines ...	62	Setting of Frame of Wharfe- dale Machine ...	48
Register on Wharfedale Machines ...	47, 84	Setting off at Hand Press ...	19
Regulation of Impression of Platen Machines ...	22	Setting the Cylinder upon the Bearers ...	65
Reliance Hand Press ...	6	Sewing ...	364
Restoring Suction in Rollers	177	Sextuple Rotary Press, Special Points ...	159
Retree Papers ...	259	Shade, Definition of ...	187
Reversing Motion of Machines	301	Side Bearings of Types ...	287
Riders of Wharfedale Machine ...	47, 50	Silver Bronze Printing...	250
Right and Wrong Side of Paper ...	257	Silver Inks ...	251
Rolled Paper... ...	258	Simple Rotary Printing Machine ...	136
Roller Casting ...	167, 171	Single Printing Unit of Rotary Web Printing Machines...	143
Roller Compositions ...	168	Slogger Feeder ...	113
Roller Moulds ...	171, 172, 173	Slurring at Hand Press ...	19
Rollers and Changes of Temperature ...	176	Slurring in Cylinder Machine Work ...	64
Rollers for Bronze Printing	246	Slurring on Platen Machines	38
Rollers for Colour Printing 204, 208		Small Printers and the Cost- keeping System ...	371
Rollers for Hand Presses ...	3	Soft Paper ...	261
Rollers, Geared, of Wharfe- dale Machine ...	50		
Rollers, Keeping in Condition	175		
Rollers, Qualities of ...	167, 174		
Rollers, Seasoning ...	174		

INDEX.

	PAGE.		PAGE.
Spaces, How Cast	293	Three-Colour Printing... ..	227
Special Points of Art		Three-Colour Combinations	192
Rotaries	165	Three-Colour Combinations	
Spectral Colours, Definition of	188	including Black	194
Spring Points	17	Three-Colour Process Block	
Springs of Machines	302	Making	296
Springing of Formes in		Through Stitching	314
Cylinder Machine Work	63	Throw-off of Platen Machines	23
Springy Formes on Platen		Throw of Wharfedale	
Machines	38	Machine	43
Spur Wheels of Wharfedale		Time Dockets, Utility of ...	371
Machine	43	Tint, Definition of..	187
Standing Press, the	314	Tints for Grounds... ..	216
Stanhope Press	2	Tones, Combinations of ...	191
Stanhope Press Levers ...	4	Tones of Colours	203
Stays of Wharfedale Machine	48	Transfers, Letterpress ...	284
Steam Engines	323	Travel in Cylinder Machines	42
Steam Jet for Cleansing Type	182	Traverse Wheels of Wharfe-	
Steelplate Engraving	276	dale Machine	43
Stereo Metal	268	Treacle and Glue Rollers ...	168
Stereo Plates, Thickness of	268	Treadle Platen Machines ...	20
Stereotyping	266	Tub-Sized Paper	258
Stereotyping by Dry Process	268	Turbines	323
Sterling Platen Machine ...	28	Turnover and Capital	368
Stiff Inks, Working	178	Turpentine and Rollers ...	179
Stitching Equipment on Rotary		Turpentine in Washing	
Web Printing Machines	153	Formes	180
Stitching, Through	314	Two-Colour Combinations ...	189
Stitching, Wire	314	Two-Colour Machines... ..	116
Storage of Electrotypes ...	273	Two-Decker Web Machines	139
Storekeeper, Duties of ...	304	Two-Feeder Machines... ..	116
Storeroom, Management and		Two-Revolution Machines ...	97
Utility of	303	Tympans, Hand Press,	
Straight-edge, Use of... ..	73	Covering	7
Strength of Paper	262	Tympan of a Hand Press ...	3
Stretcher of Wharfedale		Tympan of a Wharfedale	
Machine	44	Machine	58
Striking the Matrix in Type		Tympan Packing for Hand	
Founding	287	Press	13
Succession of Colours	212	Tympan Sheet, Putting on... ..	13
Suction Gas Plant	324	Type Casting... ..	288
Suction, Restoring, in Rollers	177	Type Dressing	288
Summit Stop Cylinder Press	93	Type Finishing	288
Sunlight in the Printing		Type Founding	285
Office	319	Type, Jet of	289
Super-Calendering Paper		Type, Kerning	289
	255, 262	Type Metal, Alloying	288
Supplement Presses	139	Type, Selection of, for Colour	
Tandem Miehles	104	Work	206
Tandem Web Machines	139, 153	Type, Wear of, and Impres-	
Temporary or Casual		sion	71
Employment	353	Underlaying at Hand Press	14
Tertiary Colours	187	Underlaying Blocks	77
Testing Machines... ..	300	Underlaying on Wharfedale	
Testing of Ink	183	Machine Work	57

INDEX.

	PAGE.		PAGE.
Uniformity of Colour	208	Wetting Trough, the	308
Unit Principle	140	Wharfedale Machine,	
Unit System of Charging ...	369	Mechanical Features ...	41
Vacuum Bronzer, Safety ...	232	Wharfedale Machines,	
Vanishing Tint	220	Improvements in	52
Varnish for Ground Tints ...	219	White for Ground Tints ...	219
Varnish in Printing Ink ...	183	White Letter Etching Process	225
Vermilion Ink, Use of	200	White Paper	9
Vickery Feeder	113	Wicks Rotary Type Casting	
Victoria Bremner Machine ...	93	Machine	291
Victory Single Reel Web		Wilson, Mr. G. A., Inventor of	
Machine	153	the Tandem System of	
Victory Two Reel Web		Web Machines... ..	153
Machine	154	Wire Stitching	314
Victory Web Printing and		Wood Engravings Making-	
Folding Machines	138	ready	74
Wages, Computation of ...	364	Wood Letter, Washing ...	182
Wages, London	348	Wood for Ground Tints ...	217
Wages, Provincial	357	Woodcuts, Making Ready	72, 76
Walter Press	137	Working Expenses	96
Warehouseman, Duties of ...	305	Working a Perfecting	
Warehouse, Operations in ...	310	Machine	129
Warehouse Ticket	307	Working a Hand Press ...	11
Warm Colours, Definition of	187	Working of Platen Machines	34
Wash Drawings for Tone		Working the Two-Revolution	
Blocks	298	Machine	113
Washing Formes	180	Work Chargeable	370
Washing Rollers	179	Work Non-chargeable ...	370
Water-Marking of Paper ...	255	Work Produced, Finding	
Water Motors	323	Value of	371
Wavers of Wharfedale		Wove Paper	258
Machine	47	Wrapping	314
Wear of Type and Impression	71		
Web Feeding of Perfecting		Yellow, Harmonies with	190, 193
Machines	124	Yellow Ink, Use of	202
Web Machines, Flat-bed ...	161	Yew Tree Ash for Washing	
Web Machines for Curved		Formes	181
Plates... ..	133		
Web Machines, Speed of	134, 149	Zander, Mr. C. G., on Photo-	
Wetting Paper	308	Trichromatic Printing ..	229
		Zincography	284

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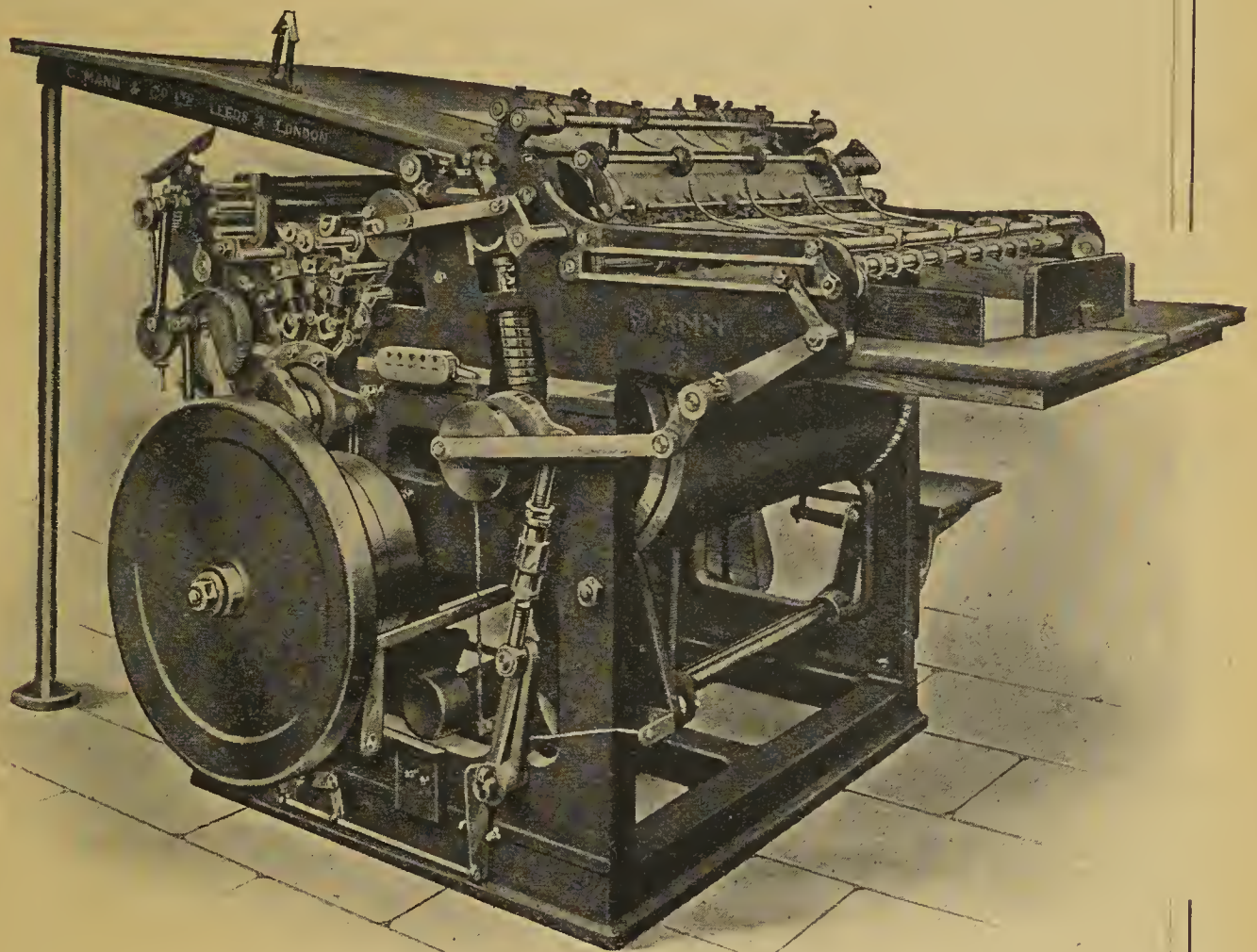
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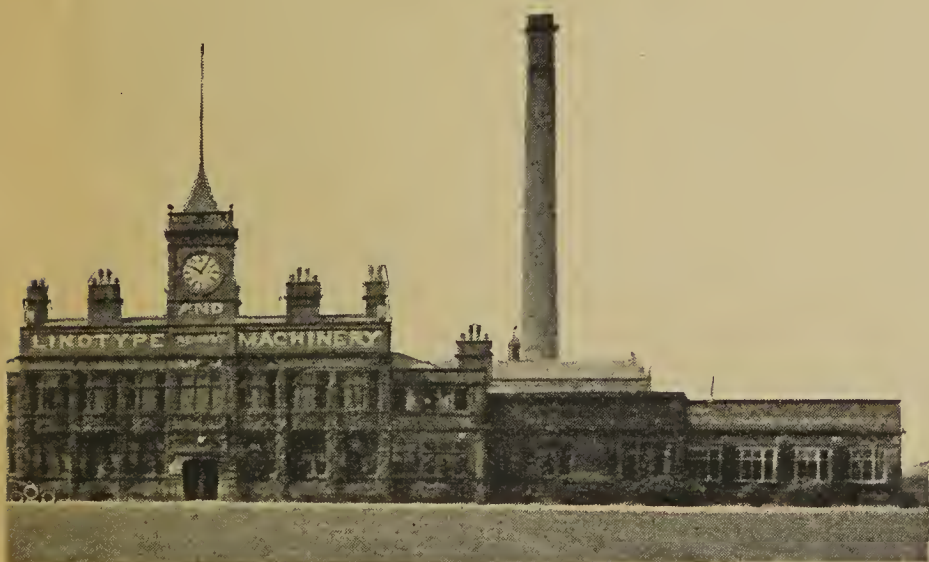
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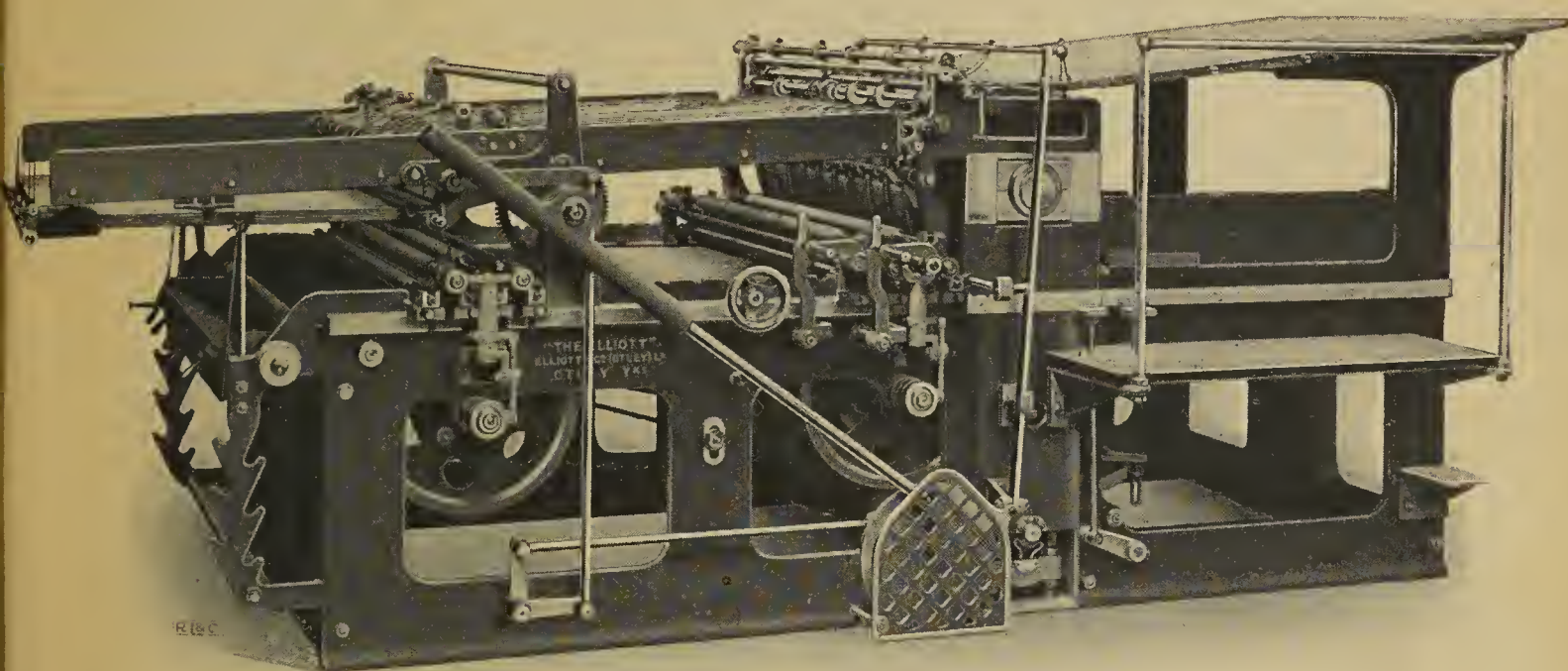
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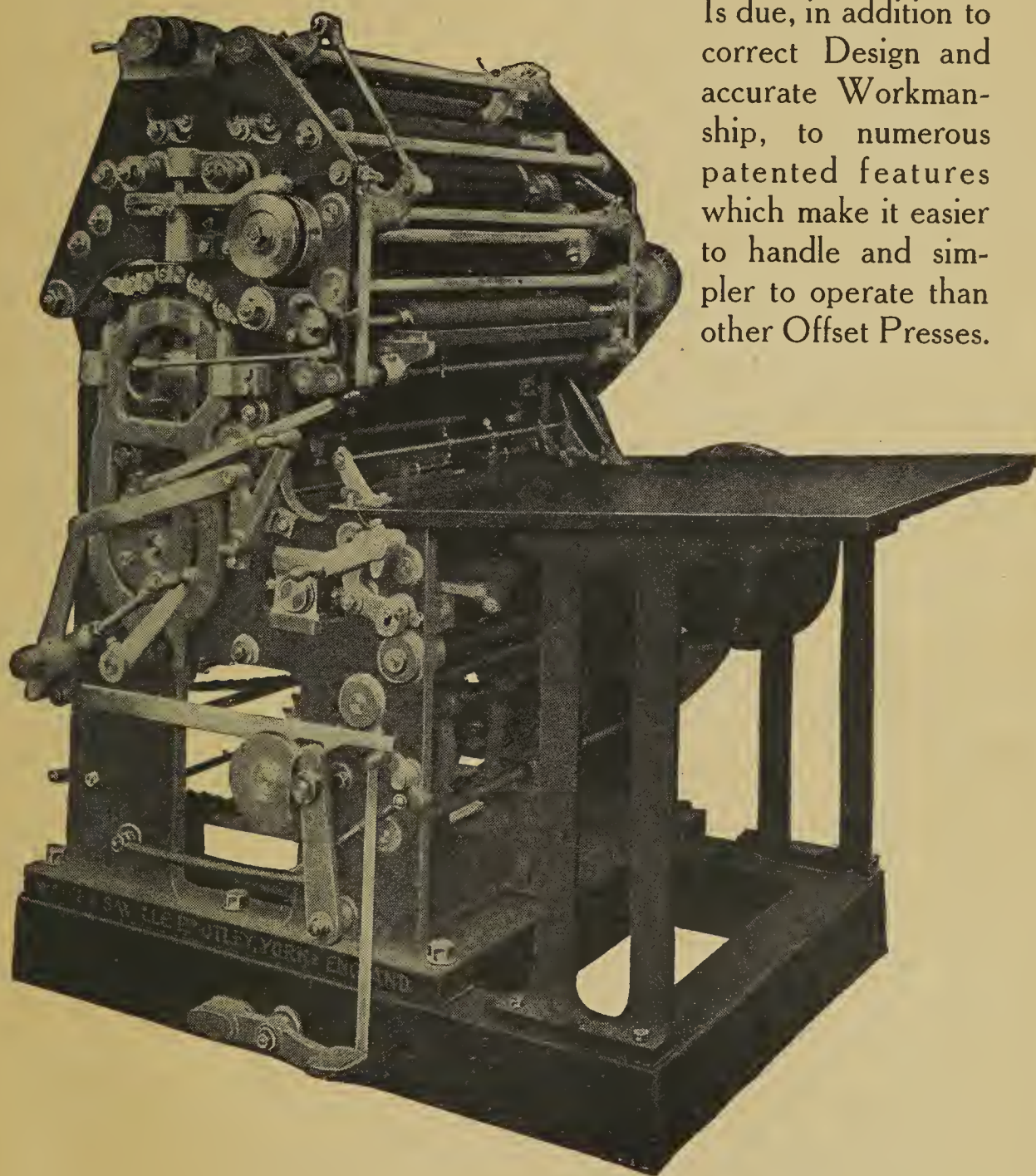
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